Time : 3 hrs.

Answers & Solutions

for

NEET (UG) - 2020 (Phase-2)

Max. Marks : 720

Important Instructions :

1.   The test is of **3 hours** duration and Test Booklet contains **180** questions. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **720**.

2.   Use **Blue / Black Ball point Pen only** for writing particulars on this page/marking responses.

3.   Rough work is to be done on the space provided for this purpose in the Test Booklet only.

4.   On completion of the test, the candidate must handover the Answer Sheet to the Invigilator before leaving the Room / Hall. *The candidates are allowed to take away* this *Test Booklet with them*.

5.   The CODE for this Booklet is **W2**.

6.   The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.

7.   Each candidate must show on demand his/her Admit Card to the Invigilator.

8.   No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.

9.   Use of Electronic/Manual Calculator is prohibited.

10.   The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.

11.   No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.

12.   The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

1. The Mean Free Path ℓ for a gas molecule depends upon diameter, d of the molecule as

   (1) $\ell \propto \dfrac{1}{d}$
   (2) $\ell \propto \dfrac{1}{d^2}$

   (3) $\ell \propto d$
   (4) $\ell \propto d^2$

Answer (2)

Sol. Mean free path (ℓ)

$$\ell = \frac{1}{\sqrt{2}n\pi d^2}$$

$$\ell \propto \frac{1}{d^2}$$

2. An intrinsic semiconductor is converted into n-type extrinsic semiconductor by doping it with

   (1) Germanium
   (2) Phosphorous

   (3) Aluminium
   (4) Silver

Answer (2)

Sol. When intrinsic semiconductor (Si or Ge) is doped with a pentavalent element, e.g. phosphorus (P), a n-type extrinsic semiconductor is created because pentavalent dopant donates one extra electron for conduction.

3. The half life of a radioactive sample undergoing α – decay is 1.4×10^{17} s. If the number of nuclei in the sample is 2.0×10^{21}, the activity of the sample is nearly

   (1) 10^3 Bq
   (2) 10^4 Bq

   (3) 10^5 Bq
   (4) 10^6 Bq

Answer (2)

Sol. The activity (A) is defined as the rate of decay of radioactive substance.

$$A = -\frac{dN}{dt} = N\lambda$$

$$A = N \times \frac{0.693}{T} \qquad \text{[T is half life]}$$

$$A = 2 \times 10^{21} \times \frac{0.693}{1.4 \times 10^{17}}$$
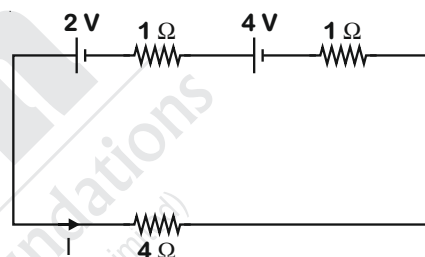
$$A = 10^4 \text{ Bq}$$

4. The E.M. wave with shortest wavelength among the following is,

   (1) Microwaves

   (2) Ultraviolet rays

   (3) X-rays

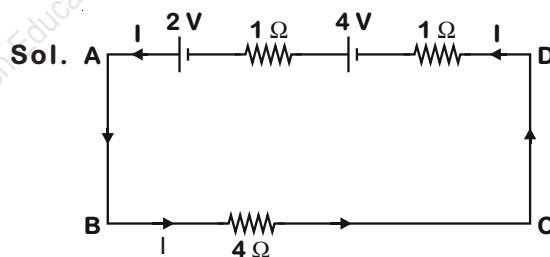   (4) Gamma-rays

Answer (4)

Sol. Gamma rays have wavelength about less than 10^{-10} m to 10^{-14} m which is shortest wavelength among all options.

5. For the circuit shown in the figure, the current I will be

   (1) 0.5 A
   (2) 0.75 A
   (3) 1 A
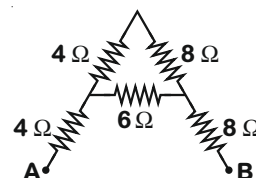   (4) 1.5 A

Answer (3)

Sol.

By KVL in a closed loop ABCDA,

$$V_A - I \times 4 - I \times 1 + 4 - I \times 1 + 2 = V_A$$
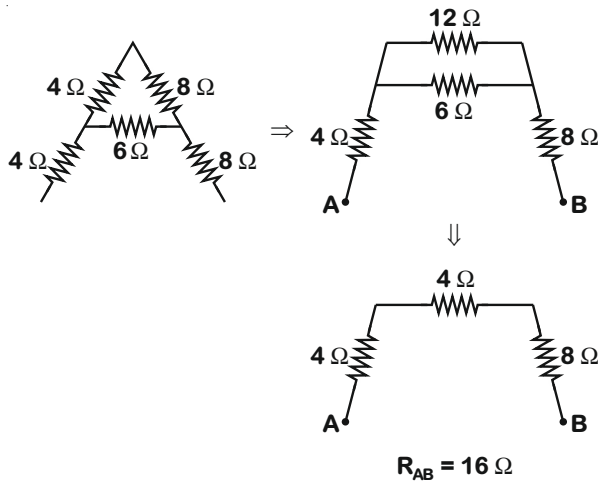
$$-6I + 6 = 0$$

$$I = 1 \text{ A}$$

6. The equivalent resistance between A and B for the mesh shown in the figure is

   (1) 4.8 Ω
   (2) 7.2 Ω
   (3) 16 Ω
   (4) 30 Ω
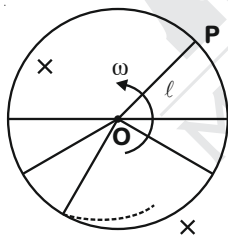
Answer (3)

Sol.

$R_{AB} = 16 \, \Omega$

7. A wheel with 20 metallic spokes each 1 m long is rotated with a speed of 120 rpm in a plane perpendicular to a magnetic field of 0.4 G. The induced emf between the axle and rim of the wheel will be (1 G = 10^{-4} T)

(1) 2.51 V

(2) 2.51×10^{-4} V

(3) 2.51×10^{-5} V

(4) 4.0×10^{-5} V

Answer (2)

Sol. Considering one spoke (OP) as given in diagram.

Induced emf across one spoke (OP),

$$e = \frac{B\omega l^2}{2}$$

$$e = \frac{1}{2} \times 0.4 \times 10^{-4} \times 2\pi \times \left(\frac{120}{60}\right) \times (1)^2$$

$$e = 2.51 \times 10^{-4} \text{ V}$$

All spokes are parallel to each other, hence net emf

$$e_{Net} = e = 2.51 \times 10^{-4} \text{ V}$$

8. Out of the following which one is a forward biased diode?

(1)

(2)

(3)

(4)

Answer (1)

Sol. In option (1), P-side is connected to the higher potential (V_H = 0 V) and N-side is connected to the lower potential (V_L = –3 V). Hence, it is forward biased.

9. A n-p-n transistor is connected in common emitter configuration (see figure) in which collector voltage drop across load resistance (800 Ω) connected to the collector circuit is 0.8 V. The collector current is
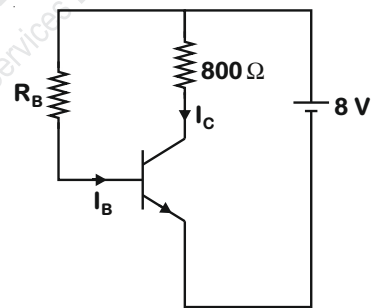
(1) 0.2 mA

(2) 2 mA

(3) 0.1 mA

(4) 1 mA

Answer (4)

Sol. Voltage drop across load resistance,

$$V_L = I_C R_C$$

$$0.8 = I_C \times 800$$

$$I_C = 1 \text{ mA}$$

10. Two solid conductors are made up of same material, have same length and same resistance. One of them has a circular cross section of area A_1 and the other one has a square cross section of area A_2. The ratio A_1/A_2 is

(1) 2

(2) 1.5

(3) 1

(4) 0.8

Answer (3)

Sol. Resistance of conductor is given as

$$R = \frac{\rho l}{A}$$

$$\therefore \quad A = \frac{\rho l}{R}$$

$$\Rightarrow \frac{A_1}{A_2} = \frac{\rho_1}{\rho_2} \times \frac{l_1}{l_2}\left(\frac{R_2}{R_1}\right)$$

$$\Rightarrow \frac{A_1}{A_2} = 1 \qquad [\because R_1 = R_2, l_1 = l_2 \text{ and for same}$$

material $\rho_1 = \rho_2$]

11. Two coherent sources of light interfere and produce fringe pattern on a screen. For central maximum, the phase difference between the two waves will be,

(1) $\pi/2$ (2) Zero

(3) π (4) $3\pi/2$

Answer (2)

Sol. For central maximum, path difference is zero hence phase difference for coherent sources of light will be zero.

$$\therefore \quad \phi = \frac{2\pi}{\lambda}\Delta x$$

where Δx is path difference and ϕ is phase difference.

12. Time intervals measured by a clock give the following readings :

1.25 s, 1.24 s, 1.27 s, 1.21 s and 1.28 s

What is the percentage relative error of the observations?

(1) 1.6% (2) 2%

(3) 4% (4) 16%

Answer (1)

Sol. The arithmetic mean of given values is taken as true value.

$$t_{mean} = \frac{t_1 + t_2 + t_3 + t_4 + t_5}{5}$$
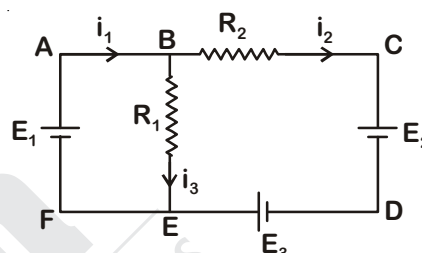
$$t_{mean} = \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5}$$

$$t_{mean} = 1.25 \text{ s}$$

$$\Delta t_{mean} = \frac{|\Delta t_1| + |\Delta t_2| + |\Delta t_3| + |\Delta t_4| + |\Delta t_5|}{5}$$

$$\Delta t_{mean} = \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5} = 0.02 \text{ s}$$

$$\text{Percentage error} = \frac{\Delta t_{mean}}{t_{mean}} \times 100 = \frac{0.02}{1.25} \times 100$$

$$= 1.6\%$$

13. For the circuit given below, the Kirchoff's loop rule for the loop BCDEB is given by the equation

(1) $-i_2 R_2 + E_2 + E_3 + i_3 R_1 = 0$

(2) $-i_2 R_2 + E_2 - E_3 + i_3 R_1 = 0$

(3) $i_2 R_2 + E_2 - E_3 - i_3 R_1 = 0$

(4) $i_2 R_2 + E_2 + E_3 + i_3 R_1 = 0$

Answer (3)

Sol. In a loop BCDEB by KVL

$$V_B - i_2 R_2 - E_2 + E_3 + i_3 R_1 = V_B$$

$$i_2 R_2 + E_2 - E_3 - i_3 R_1 = 0$$

14. An ideal gas equation can be written as

$$P = \frac{\rho R T}{M_0}$$

where ρ and M_0 are respectively,

(1) Number density, mass of the gas

(2) Mass density, mass of the gas

(3) Number density, molar mass

(4) Mass density, molar mass

Answer (4)

Sol. Perfect gas equation can be written as

$$PV = \mu RT$$

$$PV = \frac{M}{M_0}RT$$

$$P = \left(\frac{M}{V}\right)\frac{RT}{M_0}$$

$$P = \frac{\rho R T}{M_0}$$

where ρ is mass density and M_0 is molar mass.

15. The magnetic flux linked with a coil (in Wb) is given by the equation

$\phi = 5t^2 + 3t + 16$

The magnitude of induced emf in the coil at the fourth second will be

(1) 10 V (2) 33 V

(3) 43 V (4) 108 V

Answer (3)

Sol. The magnitude of induced emf is given by

$|\varepsilon| = \dfrac{d\phi_B}{dt} = \dfrac{d}{dt}(5t^2 + 3t + 16)$

$|\varepsilon| = 10t + 3 + 0$

at $t = 4$ s

$|\varepsilon| = 10 \times 4 + 3$

$|\varepsilon| = 43$ V

16. The length of the string of a musical instrument is 90 cm and has a fundamental frequency of 120 Hz. Where should it be pressed to produce fundamental frequency of 180 Hz?

(1) 80 cm (2) 75 cm

(3) 60 cm (4) 45 cm

Answer (3)

Sol. Frequency of stretched string

$n = \dfrac{1}{2\ell}\sqrt{\dfrac{T}{m}}$

If T and m are constant

$n \propto \dfrac{1}{\ell}$

$\dfrac{n'}{n} = \dfrac{\ell}{\ell'}$

$\dfrac{180}{120} = \dfrac{90}{\ell'}$

$\ell' = 60$ cm

17. The magnetic field in a plane electromagnetic wave is given by,

$B_y = 2 \times 10^{-7} \sin(\pi \times 10^3 x + 3\pi \times 10^{11} t)T$

Calculate the wavelength.

(1) $\pi \times 10^{-3}$ m (2) $\pi \times 10^3$ m

(3) 2×10^{-3} m (4) 2×10^3 m

Answer (3)

Sol. $B_y = 2 \times 10^{-7} \sin(\pi \times 10^3 x + 3\pi \times 10^{11} t)$ T

General equation of magnetic field vector

$B = B_0 \sin(kx + \omega t)$ T

$k = \pi \times 10^3$

$\dfrac{2\pi}{\lambda} = \pi \times 10^3$

$\lambda = 2 \times 10^{-3}$ m

18. A barometer is constructed using a liquid (density = 760 kg/m³). What would be the height of the liquid column, when a mercury barometer reads 76 cm?

(density of mercury = 13600 kg/m³)

(1) 0.76 m (2) 1.36 m

(3) 13.6 m (4) 136 m

Answer (3)

Sol. Pressure, $P = hdg$

Reading of mercury barometer, h = 76 cm

Reading of liquid barometer = h′

$h' d_\ell g = h d_{hg} g$

$h' = \dfrac{76 \times 13600}{760} = 1360$ cm

$= 13.6$ m

19. The P-V diagram for an ideal gas in a piston cylinder assembly undergoing a thermodynamic process is shown in the figure. The process is
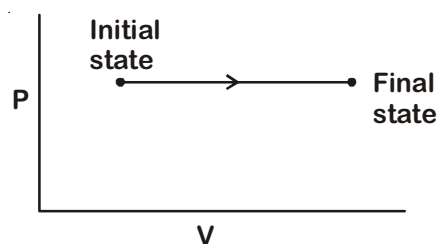
(1) isothermal (2) adiabatic

(3) isochoric (4) isobaric

Answer (4)

Sol. Because pressure remains same during the process, so it is isobaric process.

20. The efficiency of a Carnot engine depends upon

(1) the temperature of the source only

(2) the temperature of the sink only

(3) the temperatures of the source and sink

(4) the volume of the cylinder of the engine

Answer (3)

Sol. Efficiency of Carnot engine

$$\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100\%$$

So efficiency depends on temperature of source (T_1) and temperature of sink (T_2).

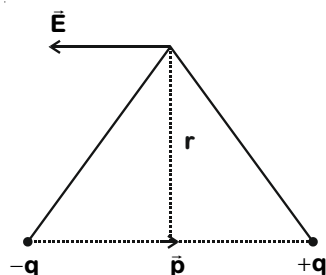**21.** The electric field at a point on the equatorial plane at a distance r from the centre of a dipole having dipole moment $\vec{p}$ is given by,

(r >> separation of two charges forming the dipole, $\in_0$ - permittivity of free space)

(1) $\vec{E} = -\dfrac{\vec{P}}{4\pi \in_0 r^3}$
(2) $\vec{E} = \dfrac{\vec{P}}{4\pi \in_0 r^3}$

(3) $\vec{E} = \dfrac{2\vec{P}}{4\pi \in_0 r^3}$
(4) $\vec{E} = -\dfrac{\vec{P}}{4\pi \in_0 r^2}$

Answer (1)

Sol. Electric field in equitorial plane

$$\vec{E} = -\frac{1}{4\pi \in_0} \frac{\vec{P}}{r^3}$$

22. A liquid does not wet the solid surface if angle of contact is

(1) zero
(2) equal to 45°

(3) equal to 60°
(4) greater than 90°

Answer (4)

Sol. If angle of contact is greater than 90°, then liquid will not wet the wall of container.

23. Three stars A, B, C have surface temperatures T_A, T_B, T_C respectively. Star A appears bluish, star B appears reddish and star C yellowish. Hence,

(1) $T_A > T_C > T_B$

(2) $T_A > T_B > T_C$

(3) $T_B > T_C > T_A$

(4) $T_C > T_B > T_A$

Answer (1)

Sol. According to Wien's Law

$$\lambda_m T = \text{constant}$$

$$T \propto \frac{1}{\lambda_m}$$

as $\lambda_B < \lambda_Y < \lambda_R$

$T_A > T_C > T_B$

24. A light bulb and an inductor coil are connected to an ac source through a key as shown in the figure below. The key is closed and after sometime an iron rod is inserted into the interior of the inductor. The glow of the light bulb
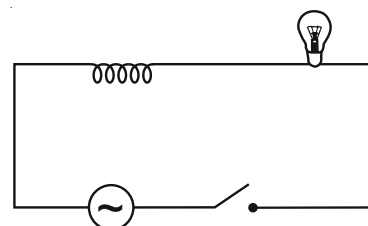
(1) increases

(2) decreases

(3) remains unchanged

(4) will fluctuate

Answer (2)

Sol. As an iron rod is inserted, inductance of inductor will increase. Hence impedance

$z = \sqrt{R^2 + (\omega L)^2}$, will increase, so from $i = \dfrac{V}{z}$

current will decrease and from $P = \dfrac{V_0^2 R}{2z^2}$ power of bulb will decrease.

25. Three identical spheres, each of mass M, are placed at the corners of a right angle triangle with mutually perpendicular sides equal to 2 m (see figure). Taking the point of intersection of the two mutually perpendicular sides as the origin, find the position vector of centre of mass.

(1) $\dfrac{4}{3}(\hat{i}+\hat{j})$

(2) $2(\hat{i}+\hat{j})$

(3) $(\hat{i}+\hat{j})$
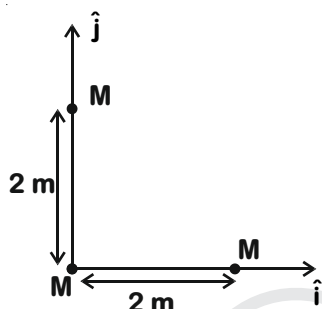
(4) $\dfrac{2}{3}(\hat{i}+\hat{j})$

Answer (4)

Sol. $x_{cm} = \dfrac{M\times 0 + M\times 0 + M\times 2}{3M} = \dfrac{2}{3}$

$y_{cm} = \dfrac{M\times 0 + M\times 0 + M\times 2}{3M} = \dfrac{2}{3}$

$\vec{r}_{cm} = \dfrac{2}{3}(\hat{i}+\hat{j})$

26. The de Broglie wavelength of an electron moving with kinetic energy of 144 eV is nearly

(1) 102×10^{-2} nm

(2) 102×10^{-3} nm

(3) 102×10^{-4} nm

(4) 102×10^{-5} nm

Answer (2)

Sol. de Broglie wavelength of electron,

$\lambda = \dfrac{12.27}{\sqrt{k(\text{in eV})}}\,\text{Å}$

$= \dfrac{12.27}{\sqrt{144}} = \dfrac{12.27}{12} = 1.02\,\text{Å}$

$= 102 \times 10^{-3}$ nm

27. The angle of 1′ (minute of arc) in radian is nearly equal to

(1) 1.75×10^{-2} rad

(2) 2.91×10^{-4} rad

(3) 4.85×10^{-4} rad

(4) 4.80×10^{-6} rad

Answer (2)

Sol. $\theta = 1' = \left(\dfrac{1}{60}\right)^0 = \left(\dfrac{1}{60}\right)\dfrac{\pi}{180}$ radian

$= 2.91 \times 10^{-4}$ radian

28. The total energy of an electron in the nth stationary orbit of the hydrogen atom can be obtained by

(1) $E_n = -13.6 \times n^2$ eV

(2) $E_n = \dfrac{13.6}{n^2}$ eV

(3) $E_n = -\dfrac{13.6}{n^2}$ eV

(4) $E_n = -\dfrac{1.36}{n^2}$ eV

Answer (3)

Sol. Energy of electron in n^{th} orbit of hydrogen atom, $E_n = -\dfrac{13.6}{n^2}$ eV

29. A wire of length L metre carrying a current of I ampere is bent in the form of circle. Its magnetic moment is

(1) $I L^2/4\pi$ A m²

(2) $I L^2/4$ A m²

(3) $I\pi L^2/4$ A m²

(4) $2I L^2/\pi$ A m²

Answer (1)

Sol. Length of wire, L = 2πR

Radius of loop, $R = \dfrac{L}{2\pi}$

Magnetic moment, M = IA

$= I\left(\dfrac{\pi L^2}{4\pi^2}\right)$

$= \dfrac{I L^2}{4\pi}$ A m²

30. What is the depth at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times the value that at the surface of earth? (radius of earth = R)

(1) $\frac{R}{n}$

(2) $\frac{R}{n^2}$

(3) $\frac{R(n-1)}{n}$

(4) $\frac{Rn}{(n-1)}$

Answer (3)

Sol. Value of acceleration due to gravity at depth d,

$$g' = g\left(1 - \frac{d}{R}\right)$$

$$\frac{g}{n} = g\left(1 - \frac{d}{R}\right)$$

$$1 - \frac{d}{R} = \frac{1}{n}$$

$$\frac{d}{R} = 1 - \frac{1}{n} = \left(\frac{n-1}{n}\right)$$

$$d = R\left(\frac{n-1}{n}\right)$$

31. An object is placed on the principal axis of a concave mirror at a distance of 1.5 f (f is the focal length). The image will be at,

(1) 3f

(2) –3f

(3) 1.5 f

(4) –1.5f

Answer (2)

Sol. By mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{\frac{3f}{2}} = \frac{1}{-f}$$

$$\frac{1}{v} - \frac{2}{3f} = -\frac{1}{f}$$

$$\frac{1}{v} = -\frac{1}{f} + \frac{2}{3f}$$

$$\frac{1}{v} = \frac{-3+2}{3f}$$

$$v = -3f$$

32. The angular speed of the wheel of a vehicle is increased from 360 rpm to 1200 rpm in 14 second. Its angular acceleration is,

(1) 1 rad/s²

(2) 2π rad/s²

(3) 28π rad/s²

(4) 120π rad/s²

Answer (2)

Sol. ω_0 = 360 rpm = $360 \times \frac{2\pi}{60}$ = 12π rad/s

ω = 1200 rpm = $1200 \times \frac{2\pi}{60}$ = 40π rad/s

By $\omega = \omega_0 + \alpha t$

40π = 12π + 14(α)

$\alpha = \frac{28\pi}{14}$ α = 2π rad/s²

33. The acceleration of an electron due to the mutual attraction between the electron and a proton when they are 1.6 Å apart is,

$(m_e \simeq 9 \times 10^{-31}\,kg,\ e = 1.6 \times 10^{-19}\,C)$

(Take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\,Nm^2\,C^{-2}$)

(1) 10^{25} m/s²

(2) 10^{24} m/s²

(3) 10^{23} m/s²

(4) 10^{22} m/s²

Answer (4)

Sol. $F = \frac{e^2}{4\pi\varepsilon_0 r^2}$

$$a_e = \frac{F}{m_e}$$

$$a_e = \frac{e^2}{4\pi\varepsilon_0 m_e r^2}$$

$$a_e = \frac{9 \times 10^9 \times (1.6)^2 \times 10^{-38}}{9 \times 10^{-31} \times (1.6)^2 \times 10^{-20}}$$

$a_e = 10^{22}$ m/s²

34. What happens to the mass number and atomic number of an element when it emits γ-radiation?

(1) Mass number increases by four and atomic number increases by two.

(2) Mass number decreases by four and atomic number decreases by two.

(3) Mass number and atomic number remain unchanged.

(4) Mass number remains unchanged while atomic number decreases by one.

Answer (3)

Sol. $_ZX^A \xrightarrow{\gamma\text{ decay}} {}_ZX^A$

Hence due to gamma emission, there is no change in mass number and atomic number.

35. If the critical angle for total internal reflection from a medium to vacuum is 45°, then velocity of light in the medium is,

(1) 3 × 10⁸ m/s

(2) 1.5 × 10⁸ m/s

(3) $\dfrac{3}{\sqrt{2}} \times 10^8$ m/s

(4) $\sqrt{2} \times 10^8$ m/s

Answer (3)

Sol. $\sin C = \dfrac{1}{\mu}$

$\sin 45° = \dfrac{1}{\mu}$

$\dfrac{1}{\sqrt{2}} = \dfrac{1}{\mu}$

$\mu = \sqrt{2}$

Velocity of light in medium

$v = \dfrac{c}{\mu}$

$v = \dfrac{3 \times 10^8}{\sqrt{2}}$ m/s

36. Calculate the acceleration of the block and trolly system shown in the figure. The coefficient of kinetic friction between the trolly and the surface is 0.05. (g = 10 m/s², mass of the string is negligible and no other friction exists).
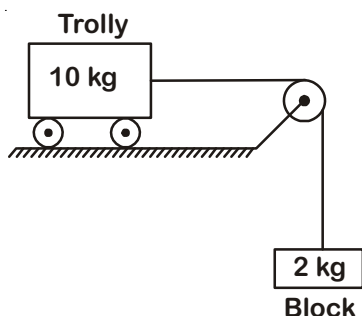
(1) 1.00 m/s²

(2) 1.25 m/s²

(3) 1.50 m/s²

(4) 1.66 m/s²

Answer (2)

Sol.
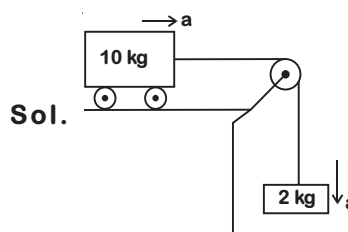
F. B. D. of trolly
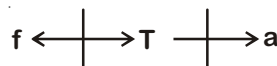
$T - f = m_T a$

$f = \mu m_T g$

$f = 0.05 \times 10 \times 10$

$f = 5$ N

$T - 5 = 10a$ ...(i)

F.B.D. of block

$m_b g - T = m_b a$

$2 \times 10 - T = 2a$

$20 - T = 2a$ ...(ii)

Equation (i) + (ii)

$15 = 12a$

$a = \dfrac{15}{12} \Rightarrow a = 1.25$ m/s²

37. A point mass 'm' is moved in a vertical circle of radius 'r' with the help of a string. The velocity of the mass is $\sqrt{7gr}$ at the lowest point. The tension in the string at the lowest point is

(1) 1 mg

(2) 6 mg

(3) 7 mg

(4) 8 mg

Answer (4)
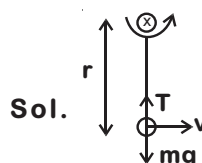
Sol.

$T - mg = \dfrac{mv^2}{r}$

$T - mg = \dfrac{m(7gr)}{r}$

T = 8 mg

38. A plano-convex lens of unknown material and unknown focal length is given. With the help of a spherometer we can measure the,

    (1) refractive index of the material

    (2) focal length of the lens

    (3) radius of curvature of the curved surface

    (4) aperture of the lens

Answer (3)

Sol. Spherometer measure the radius of curvature of the curved surface

39. A parallel plate capacitor having cross-sectional area A and separation d has air in between the plates. Now an insulating slab of same area but thickness d/2 is inserted between the plates as shown in figure having dielectric constant K(= 4). The ratio of new capacitance to its original capacitance will be,
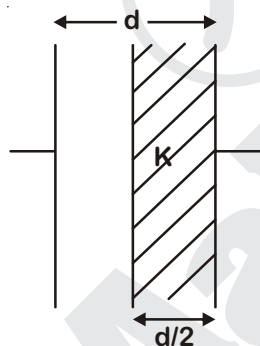
    (1) 4 : 1   (2) 2 : 1

    (3) 8 : 5   (4) 6 : 5

Answer (3)

Sol. $C_0 = \dfrac{\varepsilon_0 A}{d}$

After inserting dielectric

$C = \dfrac{\varepsilon_0 A}{(d-t) + \dfrac{t}{k}}$

$= \dfrac{\varepsilon_0 A}{\dfrac{d}{2} + \dfrac{d}{8}}$

$= \dfrac{8\varepsilon_0 A}{5d}$

$= \dfrac{8}{5} C_0$

So, $\dfrac{C}{C_0} = \dfrac{8}{5}$

40. The power of a biconvex lens is 10 dioptre and the radius of curvature of each surface is 10 cm. Then the refractive index of the material of the lens is,

    (1) $\dfrac{3}{2}$ (2) $\dfrac{4}{3}$

    (3) $\dfrac{9}{8}$ (4) $\dfrac{5}{3}$

Answer (1)

Sol. $\dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

as $P = \dfrac{1}{f(\text{in m})}$

$10 = (\mu - 1)\left(\dfrac{1}{0.10} + \dfrac{1}{0.10}\right)$

$(\mu - 1) = \dfrac{1}{2}$

$\mu = \dfrac{3}{2}$

41. The variation of electrostatic potential with radial distance r from the centre of a positively charged metallic thin shell of radius R is given by the graph

    (1)

    (2)

    (3)

    (4)

Answer (3)

Sol.
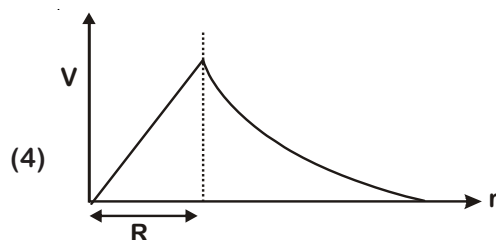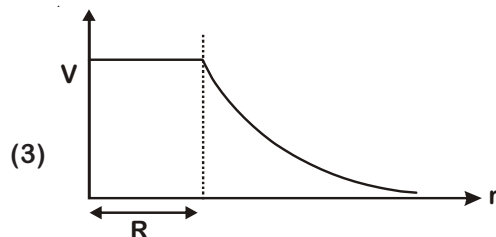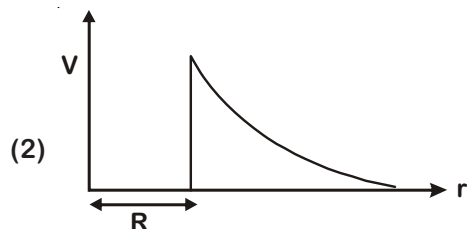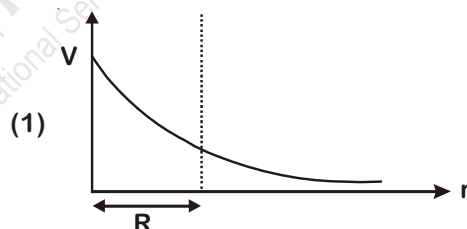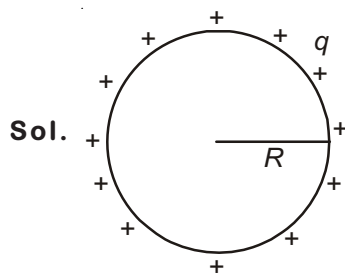
for r < R

$$V = \frac{q}{4\pi\varepsilon_0 R} = \text{constant}$$

for r ≥ R

$$V = \frac{q}{4\pi\varepsilon_0 r} = V \propto \frac{1}{r}$$
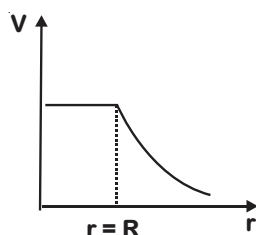
42. Which of the following gate is called universal gate ?

    (1) NOT gate

    (2) OR gate

    (3) AND gate

    (4) NAND gate

Answer (4)

Sol. With the help of NAND gate any logic function or gate can be realized. Hence it is called as universal gate.

43. Identify the function which represents a periodic motion.

    (1) $e^{-\omega t}$

    (2) $e^{\omega t}$

    (3) $\log_e(\omega t)$

    (4) $\sin\omega t + \cos\omega t$

Answer (4)

Sol. For periodic function

$$f(t) = f(t + T)$$

where T is time period of function

$$\sin(\omega t + 2\pi) + \cos(\omega t + 2\pi)$$

$$= \sin\omega t + \cos\omega t$$

44. The wave nature of electrons was experimentally verified by,

    (1) Davisson and Germer

    (2) de Broglie

    (3) Hertz

    (4) Einstein

Answer (1)

Sol. The wave nature of electrons was experimentally verified by Davisson and Germer.

45. A person sitting in the ground floor of a building notices through the window, of height 1.5 m, a ball dropped from the roof of the building crosses the window in 0.1 s. What is the velocity of the ball when it is at the topmost point of the window ? (g–10 m/s²)

    (1) 20 m/s

    (2) 15.5 m/s

    (3) 14.5 m/s

    (4) 4.5 m/s

Answer (3)
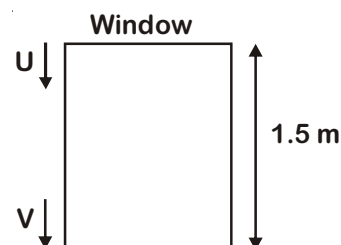
Sol.

From equation of motion

$$S = ut + \frac{1}{2}at^2$$

$$1.5 = u(0.1) + \frac{1}{2} \times 10(0.1)^2$$

1.5 = (0.1) u + 0.05

u = 15 – 0.5

   = 14.5 m/s

46. Which among the following salt solutions is basic in nature?

(1) Sodium acetate

(2) Ammonium chloride

(3) Ammonium sulphate

(4) Ammonium nitrate

Answer (1)

Sol. Sodium acetate is a salt of strong base and weak acid therefore its salt solution is basic in nature.

47. If 8 g of a non-electrolyte solute is dissolved in 114 g of n-octane to reduce its vapour pressure to 80%, the molar mass (in g mol^{-1}) of the solute is [Given that molar mass of n-octane is 114 g mol^{-1}]

(1) 20

(2) 40

(3) 60

(4) 80

Answer (2)

Sol. Assuming dilute solution

$$\frac{\Delta P}{P_A^0} = \frac{n_B}{n_A} = \frac{w_B}{m_B} \cdot \frac{m_A}{w_A}$$

$$\frac{20}{100} = \frac{8}{m_B} \cdot \frac{114}{114}$$

$$m_B = \frac{8 \times 100}{20} = 40 \text{ gmol}^{-1}$$

48. Identify compound (A) in the following reaction:

A $\xrightarrow{\text{H}_2|\text{Pd}|\text{BaSO}_4}$ CHO

(1) Benzoic acid
(2) Benzoyl chloride

(3) Toluene
(4) Acetophenone

Answer (2)

Sol. COCl $\xrightarrow{\text{H}_2/\text{Pd}/\text{BaSO}_4}$ CHO
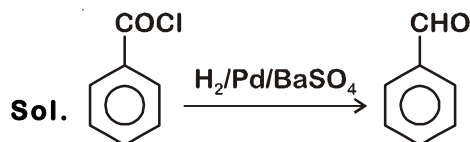
Rosenmund reduction

49. Identify the **incorrect** statement from the following :

(1) The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoid contraction

(2) Zirconium and Hafnium have identical radii of 160 pm and 159 pm, respectively as a consequence of lanthanoid contraction

(3) Lanthanoids reveal only +3 oxidation state

(4) The lanthanoid ions other than the f^0 type and the f^{14} type are all paramagnetic

Answer (3)

Sol. • Lanthanoids can show +2 or +4 oxidation states in solution or in solid compounds.

• Most common oxidation state of Lanthanoids is +3.

50. The half-life for a zero order reaction having 0.02 M initial concentration of reactant is 100 s. The rate constant (in mol L^{-1} s^{-1}) for the reaction is

(1) 1.0×10^{-2}
(2) 1.0×10^{-4}

(3) 2.0×10^{-4}
(4) 2.0×10^{-3}

Answer (2)

Sol. For zero order reaction

$$t_{1/2} = \frac{a}{2k} \Rightarrow k = \frac{a}{2t_{1/2}}$$

$$k = \frac{0.02}{2 \times 100} = 1.0 \times 10^{-4} \text{ mol L}^{-1} \text{s}^{-1}$$

51. Match the coordination number and type of hybridisation with distribution of hybrid orbitals in space based on Valence bond theory.

Coordination number and type of hybridisation	Distribution of hybrid orbitals in space
(a) 4, sp^3	(i) trigonal bipyramidal
(b) 4, dsp^2	(ii) octahedral
(c) 5, sp^{3}d	(iii) tetrahedral
(d) 6, d^{2}sp^3	(iv) square planar

Select the correct option :

(1) (a)-(iii) (b)-(i) (c)-(iv) (d)-(ii)

(2) (a)-(ii) (b)-(iii) (c)-(iv) (d)-(i)

(3) (a)-(iii) (b)-(iv) (c)-(i) (d)-(ii)

(4) (a)-(iv) (b)-(i) (c)-(ii) (d)-(iii)

Answer (3)

Sol.

Hybridisation	Geometry	Coordination number
sp^3	Tetrahedral	4
dsp^2	Square planar	4
sp^3d	Trigonal bipyramidal	5
d^2sp^3	Octahedral	6

52. Match the element in column I with that in column II.

Column I	Column II
(a) Copper	(i) Non-metal
(b) Fluorine	(ii) Transition Metal
(c) Silicon	(iii) Lanthanoid
(d) Cerium	(iv) Metalloid

Identify the correct match :

(1) (a)-(i) (b)-(ii) (c)-(iii) (d)-(iv)

(2) (a)-(ii) (b)-(iv) (c)-(i) (d)-(iii)

(3) (a)-(ii) (b)-(i) (c)-(iv) (d)-(iii)

(4) (a)-(iv) (b)-(iii) (c)-(i) (d)-(ii)

Answer (3)

Sol. Copper → Transition metal

Fluorine → Non-metal

Silicon → Metalloid

Cerium → Lanthanoid

53. In collision theory of chemical reaction, Z_{AB} represents

(1) the fraction of molecules with energies equal to E_a

(2) the fraction of molecules with energies greater than E_a

(3) the collision frequency of reactants, A and B

(4) steric factor

Answer (3)

Sol. The number of collisions per second per unit volume of the reaction mixture (A and B) is known as collision frequency Z_{AB}.

54. At standard conditions, if the change in the enthalpy for the following reaction is -109 kJ mol^{-1}.
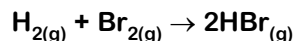
$$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$$

Given that bond energy of H_2 and Br_2 is 435 kJ mol^{-1} and 192 kJ mol^{-1}, respectively, what is the bond energy (in kJ mol^{-1}) of HBr?

(1) 259   (2) 368

(3) 736   (4) 518

Answer (2)

Sol. $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$; $\Delta H = -109$

$$\Delta H = \sum (BE)_R - \sum (BE)_P$$

$$= (BE_{H-H}) + (BE_{Br-Br}) - 2(BE_{H-Br})$$

$$-109 = (435) + (192) - 2(BE_{H-Br})$$

$$BE_{H-Br} = 368 \text{ kJ mol}^{-1}$$

55. The solubility product for a salt of the type AB is 4×10^{-8}. What is the molarity of its standard solution?

(1) 4×10^{-4} mol/L   (2) 2×10^{-4} mol/L

(3) 16×10^{-16} mol/L   (4) 2×10^{-16} mol/L

Answer (2)

Sol. For salt AB

$$K_{sp} = (s)^2 \Rightarrow s = \sqrt{K_{sp}}$$

$$s = \sqrt{4 \times 10^{-8}} = 2 \times 10^{-4} \text{ M}$$

56. The potential energy (y) curve for H_2 formation as a function of internuclear distance (x) of the H atoms is shown below.

The bond energy of H_2 is

(1) (c − a)   (2) (b − a)

(3) $\dfrac{(c-a)}{2}$ (4) $\dfrac{(b-a)}{2}$

Answer (2)

Sol. • Potential energy of two H atoms at infinite distance = a

• Potential energy of two H atoms at distance equal to bond length = b

BE = (b – a)

57. Match the elements in Column I with methods of purification in Column II.

Column I	Column II
(a) Boron	(i) Van Arkel method
(b) Tin	(ii) Mond's process
(c) Zirconium	(iii) Liquation
(d) Nickel	(iv) Zone refining

(1) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(2) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

(3) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Answer (2)

Sol.

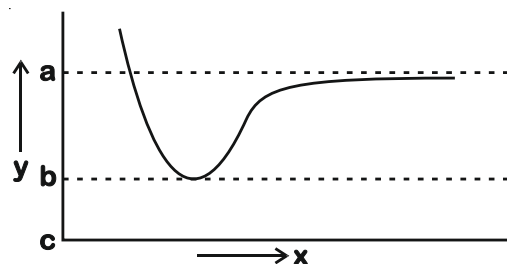| Elements	Method of purification
Boron	Zone-refining
Tin	Liquation
Zirconium	Van Arkel method
Nickel	Mond's process

58. A liquid compound (x) can be purified by steam distillation only if it is

(1) Not steam volatile, immiscible with water

(2) Steam volatile, immiscible with water

(3) Not steam volatile, miscible with water

(4) Steam volatile, miscible with water

Answer (2)

Sol. Steam distillation technique is applied to separate the substances which are steam volatile and immiscible with water.

59. What is the role of gypsum, $CaSO_4 \cdot 2H_2O$ in setting of cement? Identify the correct option from the following :

(1) to slow down the setting process

(2) to fasten the setting process

(3) to provide water molecules for hydration process

(4) to help to remove water molecules

Answer (1)

Sol. The purpose of adding gypsum is only to slow down the process of setting of cement, so that it gets sufficient hardened.

60. Which of the following substituted phenols is the strongest acid?

(1) [structure: phenol with CH₃ at para position]

(2) [structure: phenol with NO₂ at para position]

(3) [structure: phenol with OCH₃ at para position]

(4) [structure: phenol with C₂H₅ at para position]
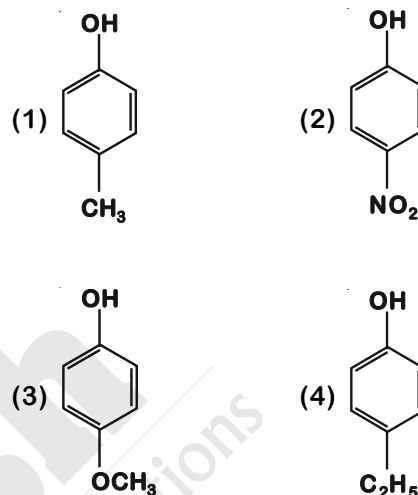
Answer (2)

Sol. Due to the presence of strongly deactivating group $-NO_2$ (–I, –R), p-nitro phenol is the strongest acid.

61. Deficiency of which vitamin causes osteomalacia?

(1) Vitamin E

(2) Vitamin A

(3) Vitamin D

(4) Vitamin K

Answer (3)

Sol. Osteomalacia is a vitamin-D deficiency disease, in which bone density decrease and bones get softer.

62. Which one of the following reactions does not come under hydrolysis type reaction ?

(1) $P_4O_{10(s)} + 6H_2O_{(l)} \rightarrow 4H_3PO_{4(aq)}$

(2) $SiCl_{4(l)} + 2H_2O_{(l)} \rightarrow SiO_{2(s)} + 4HCl_{(aq)}$

(3) $Li_3N_{(s)} + 3H_2O_{(l)} \rightarrow NH_{3(g)} + 3LiOH_{(aq)}$

(4) $2F_{2(g)} + 2H_2O_{(l)} \rightarrow 4HF_{(aq)} + O_{2(g)}$

Answer (4)

Sol. Reaction of F_2 with H_2O gives HF(aq) and O_2(g) as products in which fluorine oxidises water into oxygen which does not come under hydrolysis type reaction

63. Which one of the following compounds shows both, Frenkel as well as Schottky defects ?

    (1) ZnS   (2) AgBr

    (3) AgI   (4) NaCl

Answer (2)

Sol. AgBr shows both, Frenkel as well as Schottky defects.

64. Which of the following is **not** true about chloramphenicol ?

    (1) It is bacteriostatic.

    (2) It inhibits the growth of only gram positive bacteria.

    (3) It is a broad spectrum antibiotic.

    (4) It is not bactericidal.

Answer (2)

Sol. • **Chloramphenicol**

    It is bacteriostatic antibiotic

    It is a broad spectrum antibiotic

    It inhibits the growth of both gram-positive and gram-negative bacteria

65. The oxidation number of the underlined atom in the following species

    (1) H$\underline{Au}$Cl$_4$ is + 3

    (2) Cu$_2$$\underline{O}$ is –1

    (3) $\underline{Cl}$O$_3^-$ is +5

    (4) K$_2$$\underline{Cr}_2O_7$ is +6

    Identify the incorrect option.

Answer (2)

Sol. (1) H$\underline{Au}$Cl$_4$ $\Rightarrow$ (+1) + x + 4 (–1) = 0

                    x = +3
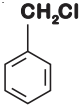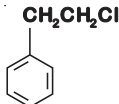
    (2) Cu$_2$$\underline{O}$ $\Rightarrow$ 2(+1) + x = 0

                    x = –2

    (3) $\underline{Cl}$O$_3^-$ $\Rightarrow$ x + 3 (–2) = –1

                    x = +5

    (4) K$_2$$\underline{Cr}_2O_7$ $\Rightarrow$ 2(+1) + 2x + 7(–2) = 0

                    x = +6

66. Which of the following will **NOT** undergo S$_N$1 reaction with $\overline{OH}$?

    (1) CH$_2$Cl (benzyl chloride)

    (2) CH$_2$ = CH – CH$_2$Cl

    (3) (CH$_3$)$_3$CCl

    (4) CH$_2$CH$_2$Cl (phenethyl chloride)

Answer (4)

Sol. Primary alkyl halide does not give S$_N$1 reaction.

67. Reaction of propanamide with ethanolic sodium hydroxide and bromine will give

    (1) Aniline   (2) Ethylamine

    (3) Methylamine   (4) Propylamine

Answer (2)

Sol.

$$CH_3CH_2CONH_2 \xrightarrow[Br_2]{NaOH/Ethanol} CH_3CH_2NH_2$$
$$(\text{Propanamide}) \qquad\qquad\qquad\qquad (\text{Ethylamine})$$

68. In which of the sols, the colloidal particles are with negative charge?

    (1) Hydrated Al$_2$O$_3$ (2) TiO$_2$

    (3) Haemoglobin   (4) Starch

Sol.

Sols	Charged on sols
Hydrated Al$_2$O$_3$	Positive
TiO$_2$	Positive
Haemoglobin	Positive
Starch	Negative

69. The minimum pressure required to compress 600 dm^3 of a gas at 1 bar to 150 dm^3 at 40°C is

    (1) 2.5 bar   (2) 4.0 bar

    (3) 0.2 bar   (4) 1.0 bar

Answer (2)

Sol. As per Boyle's Law

    P$_1$V$_1$ = P$_2$V$_2$

    (1 bar) × 600 dm^3 = P$_2$ × (150 dm^3)

    P$_2$ = 4 bar

70. The number of angular nodes and radial nodes in 3s orbital are

(1) 0 and 1, respectively

(2) 0 and 2, respectively

(3) 1 and 0, respectively

(4) 3 and 0, respectively

Answer (2)

Sol. • Number of radial nodes = $n - l - 1$

Number of angular nodes = l

∴ For 3s orbital,

• Number of radial nodes = $3 - 0 - 1 = 2$

• Number of angular nodes = 0

71. Which of the following statement is correct about Bakelite?

(1) It is a linear polymer

(2) It is a cross linked polymer

(3) It is an addition polymer

(4) It is a branched chain polymer

Answer (2)

Sol. Bakelite is a cross linked polymer of phenol and formaldehyde.

72. Among the compounds shown below which one revealed a linear structure?

(1) N_2O (2) NO_2

(3) $HOCl$ (4) O_3

Answer (1)

Sol.

73. The reaction of concentrated sulphuric acid with carbohydrates ($C_{12}H_{22}O_{11}$) is an example of

(1) Sulphonation   (2) Dehydration

(3) Oxidation   (4) Reduction

Answer (2)

Sol. Concentrated sulphuric acid is a strong dehydrating agent and it readily dehydrate carbohydrates into carbon.

74. Which of the following compound is most reactive in electrophilic aromatic substitution?
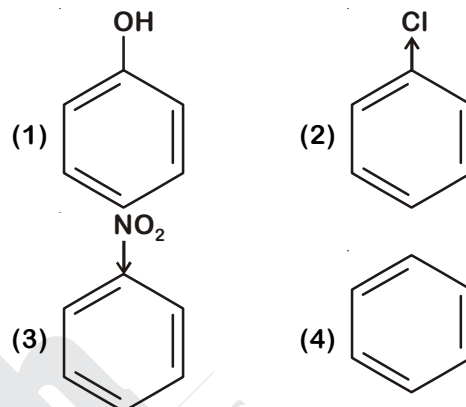
Answer (1)

Sol. • Greater is the electron density on benzene ring, greater is the reactivity towards electrophilic aromatic substitution.

• Order of Electrophilic aromatic substitution.
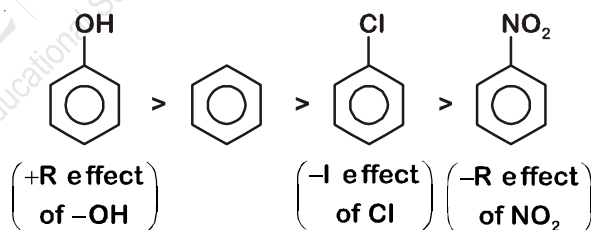
75. In a typical fuel cell, the reactant (R) and product (P) are

(1) $R = H_{2(g)} \cdot N_{2(g)}$: $P = NH_{3(aq)}$

(2) $R = H_{2(g)} \cdot O_{2(g)}$: $P = H_2O_{2(l)}$

(3) $R = H_{2(g)} \cdot O_{2(g)}$: $P = H_2O_{(l)}$

(4) $R = H_{2(g)} \cdot O_{2(g)} \cdot Cl_{2(g)}$: $P = HClO_{4(aq)}$

Answer (3)

Sol. Cell reaction involved in hydrogen-oxygen fuel cell is

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$$
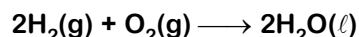
76. Identify the wrongly match pair.

Molecule	Shape or geometry of molecule
(1) NH_3	Trigonal pyramidal
(2) PCl_5	Trigonal planar
(3) SF_6	Octahedral
(4) $BeCl_2$	Linear

Answer (2)

Sol. • NH_3

Trigonal pyramidal

• PCl_5

Trigonal bipyramidal

• SF_6

Octahedral

• $BeCl_2$ $Cl—Be—Cl$ Linear
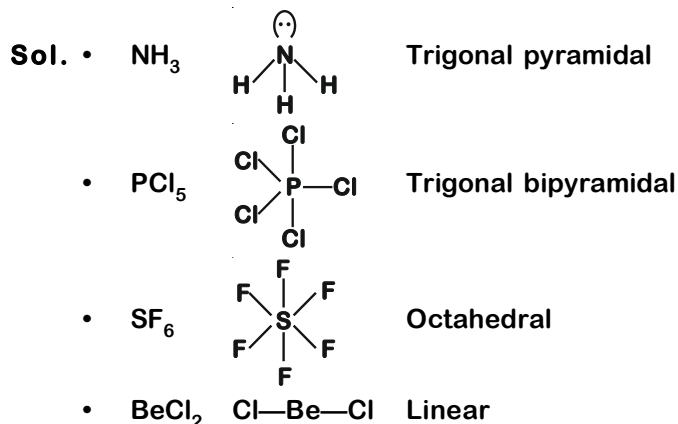
77. Which of the following statement is NOT true about acid rain?

(1) Its pH is less than 5.6

(2) It is due to reaction of SO_2, NO_2 and CO_2 with rain water

(3) Causes no damage to monuments like Taj Mahal

(4) It is harmful for plants

Answer (3)

Sol. Acid rain reacts with marble, $CaCO_3$ of Taj Mahal causing damage to it. As a result, the monument is being slowly disfigured and the marble is getting discoloured and lustreless.

78. Which of the following is a free radical substitution reaction?

(1) Propene with $HBr/(C_6H_5COO)_2$

(2) Benzene with $Br_2/AlCl_3$

(3) Acetylene with HBr

(4) Methane with $Br_2/h\nu$

Answer (4)

Sol. • $Br\overset{\frown}{-}Br \xrightarrow{h\nu} 2\dot{B}r$

• $\dot{C}H_3\overset{\frown}{-}\dot{H} \xrightarrow{h\nu} \dot{C}H_3 + \dot{H}$

• $\dot{C}H_3 + \dot{B}r \longrightarrow CH_3-Br$
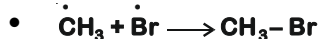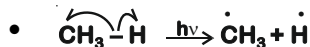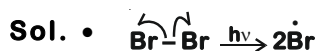
$\Rightarrow$ Reaction of methane with Br_2 in the presence of light is a free radical substitution reaction.

79. If for a certain reaction $\Delta_r H$ is 30 kJ mol^{-1} at 450 K, the value of $\Delta_r S$ (in JK^{-1} mol^{-1}) for which the same reaction will be spontaneous at the same temperature is

(1) −70   (2) 70

(3) −33   (4) 33

Answer (2)

Sol. For spontaneous reaction, $\Delta_r G$ must be less than zero.

So, $\Delta_r G = \Delta_r H - T\Delta_r S < 0$

or, $\Delta_r S > \dfrac{\Delta_r H}{T}$

$> \dfrac{30,000}{450} = 66.67$ J

$\therefore$ For reaction to be spontaneous, the value of $\Delta_r S$ must be greater than 66.67 J

80. Match the compounds of Xe in column I with the molecular structure in column II.

Column I	Column II
(a) XeF_2	(i) Square planar
(b) XeF_4	(ii) Linear
(c) XeO_3	(iii) Square pyramidal
(d) $XeOF_4$	(iv) Pyramidal

(1) (a)-(ii) (b)-(i) (c)-(iv) (d)-(iii)

(2) (a)-(ii) (b)-(i) (c)-(iii) (d)-(iv)

(3) (a)-(ii) (b)-(iv) (c)-(iii) (d)-(i)

(4) (a)-(ii) (b)-(iii) (c)-(i) (d)-(iv)

Answer (1)

Sol.

XeF_2 :

Linear

XeF_4 :

Square planar

XeO_3 :

Pyramidal

$XeOF_4$:

Square pyramidal
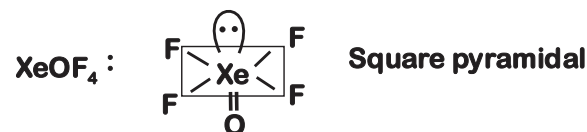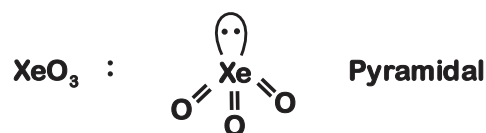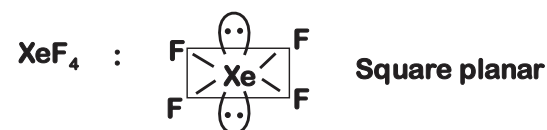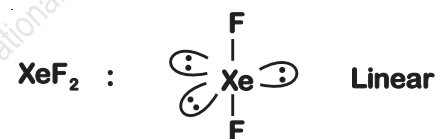
81. Which of the following statement is **not** true about glucose?

(1) It is an aldopentose.

(2) It is an aldohexose.

(3) It contains five hydroxyl groups.

(4) It is a reducing sugar.

Answer (1)

Sol. Structure of Glucose
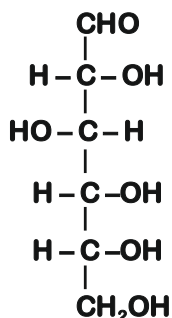
- It is an aldohexose.

- 5 –OH groups are present.

- It is a reducing sugar as it contains –CHO group.

82. Identify the correct statement from the following.

    (1) Lithium chloride is deliquescent and crystallises as a hydrate, $LiCl \cdot H_2O$.

    (2) The order of hydration enthalpies of alkaline earth cations

    $Be^{2+} < Mg^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$

    (3) Lithium and Magnesium show some similarities in their physical properties as they are diagonally placed in periodic table.

    (4) Lithium is softer among all alkali metals.

Answer (3)

Sol.
- LiCl is deliquescent and crystallises from aqueous solution as hydrate, $LiCl \cdot 2H_2O$

- The hydration enthalpies of alkaline earth metal ions decreases with increase in ionic size down the group.

- $\therefore$ Order of hydration enthalpy is

  $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

- Lithium shows diagonal relationship with magnesium hence, their physical and chemical properties are almost similar.

- Lithium is much harder than other alkali metals.

83. Identify the reaction from following having top position in EMF series (Std. red. potential) according to their electrode potential at 298 K.

    (1) $K^+ + 1e^- \rightarrow K_{(s)}$ (2) $Mg^{2+} + 2e^- \rightarrow Mg_{(s)}$

    (3) $Fe^{2+} + 2e^- \rightarrow Fe_{(s)}$ (4) $Au^{3+} + 3e^- \rightarrow Au_{(s)}$

Answer (4)

Sol.
- $Au^{3+} + 3e^- \rightarrow Au(s)$ $E° = 1.40$ V

- $Fe^{2+} + 2e^- \rightarrow Fe(s)$ $E° = -0.44$ V

- $Mg^{2+} + 2e^- \rightarrow Mg(s)$ $E° = -2.36$ V

- $K^+ + 1e^- \rightarrow K(s)$ $E° = -2.93$ V

As per electrochemical series, Au^{3+} occupies the top position.

84. Which of the following acid will form an (a) Anhydride on heating and (b) Acid imide on strong heating with ammonia?

Answer (2)

Sol.

(Phthalic anhydride)

(Phthalimide)
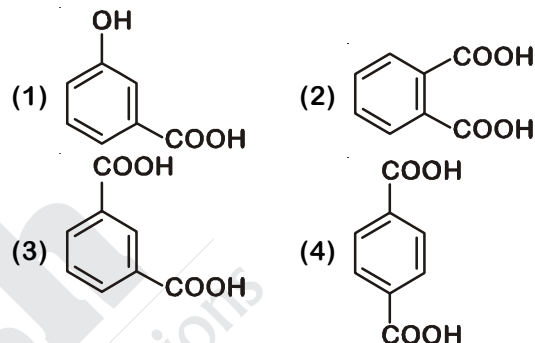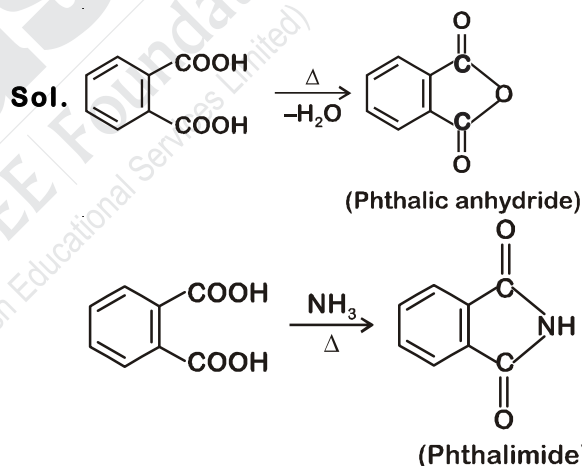
85. One mole of carbon atom weighs 12 g, the number of atoms in it is equal to, (Mass of carbon-12 is 1.9926×10^{-23} g)

    (1) 6.022×10^{23} (2) 1.2×10^{23}

    (3) 6.022×10^{22} (4) 12×10^{22}

Answer (1)

Sol. Number of atoms in 1 mole of carbon = 6.022×10^{23}

86. Which of the following oxide is amphoteric in nature?

    (1) CO_2 (2) SnO_2

    (3) SiO_2 (4) GeO_2

Answer (2)

Sol.
- CO_2 : acidic

- SnO_2 : amphoteric

- SiO_2 : acidic

- GeO_2 : acidic

87. Match the following aspects with the respective metal.

Aspects	Metal
(a) The metal which reveals a maximum number of oxidation states	(i) Scandium
(b) The metal although placed in 3d block is considered not as a transition element	(ii) Copper
(c) The metal which does not exhibit variable oxidation states	(iii) Manganese
(d) The metal which in +1 oxidation state in aqueous solution undergoes disproportionation	(iv) Zinc

Select the correct option :

(1) (a)-(ii) (b)-(iv) (c)-(i) (d)-(iii)

(2) (a)-(i) (b)-(iv) (c)-(ii) (d)-(iii)

(3) (a)-(iii) (b)-(iv) (c)-(i) (d)-(ii)

(4) (a)-(iii) (b)-(i) (c)-(iv) (d)-(ii)

Answer (3)

Sol. • In 3d-series, Manganese reveals maximum number of oxidation states i.e., (+2 to +7)

• Zinc atom has completely filled d-orbitals in its ground state as well as in its oxidised state, hence it is not regarded as a transition element.

• Scandium shows only one oxidation state i.e., +3.

• Cu^+ undergoes disproportionation reaction in aqueous solution

$$2Cu^+(aq) \longrightarrow Cu^{2+}(aq) + Cu(s)$$

88. $CH_3CH_2CH = CH_2 \xrightarrow[H_2O, H_2O_2, OH^-]{B_2H_6} Z$.
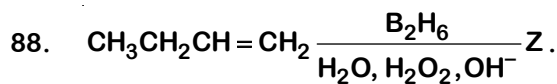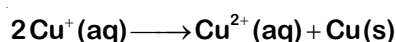
What is Z?

(1) $CH_3CH_2CH_2CH_3$

(2) $CH_3CH_2CH_2CH_2OH$

(3) $CH_3CH_2\overset{\underset{\displaystyle |}{OH}}{C}HCH_3$

(4) $CH_3CH_2CH_2CHO$

Answer (2)

Sol.

$CH_3 - CH_2 - CH = CH_2 \xrightarrow{B_2H_6} CH_3 - CH_2 - \underset{H}{C}H - \underset{BH_2}{C}H_2$

$\downarrow CH_3CH_2CH = CH_2$

$(CH_3 - CH_2 - CH_2 - CH_2)_2BH \xleftarrow{CH_3 - CH_2 - CH = CH_2}$

$(CH_3 - CH_2 - CH_2 - CH_2)_3B$

$\downarrow 3H_2O_2, OH^- | H_2O$

$3CH_3CH_2CH_2CH_2\overset{\displaystyle OH}{|} + B(OH)_3$

Butan-1 ol
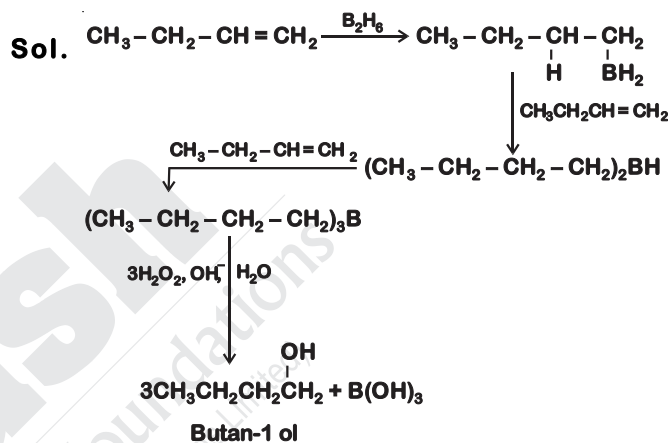
89. Isotonic solutions have same

(1) Boiling temperature

(2) Vapour pressure

(3) Freezing temperature

(4) Osmotic pressure

Answer (4)

Sol. Solutions having same osmotic pressure at a given temperature are called isotonic solutions.

90. How many (i) sp^2 hybridised carbon atoms and (ii) π bonds are present in the following compound?
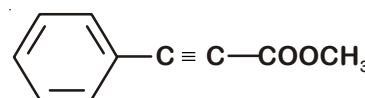
(1) 8, 5   (2) 7, 5

(3) 8, 6   (4) 7, 6

Answer (4)

Sol.
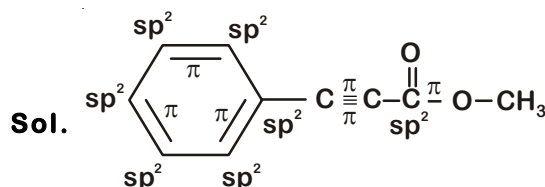
Number of sp^2 hybridised carbon atoms is 7

Number of π bonds is 6

91. Chromosomal theory of inheritance was proposed by

(1) Watson and Crick

(2) Sutton and Boveri

(3) Bateson and Punnet

(4) T.H. Morgan

Answer (2)

Sol. Chromosomal theory of inheritance was proposed by Sutton and Boveri.

92. Which of the following is **incorrect** about Cynobacteria?

(1) They have chlorophyll 'a' similar to green plants

(2) They are photoautotrophs

(3) They lack heterocysts

(4) They often form blooms in polluted water bodies

Answer (3)

Sol. Cynobacteria have heterocyst that fixes atmospheric nitrogen to ammonia.

93. The impact of immigration on population density is

(1) Positive

(2) Negative

(3) Both positive and negative

(4) Neutralized by natality

Answer (1)

Sol. Immigration is the movement of individuals of the same species into a given habitat from elsewhere so it will increase the population density of the species in that area. So, it has positive impact.

94. Which of the following statements is **incorrect**?

(1) RuBisCO action requires ATP and NADPH

(2) RuBisCO is a bifunctional enzyme

(3) In C_4 plants, the site of RuBisCO activity is mesophyll cell

(4) The substrate molecule for RuBisCO activity is a 5-carbon compound

Answer (3)

Sol. In C_4 plants, the site of RuBisCO activity is bundle sheath cells.

95. Inclusion bodies of blue-green, purple and green photosynthetic bacteria are

(1) Microtubules

(2) Contractile vacuoles

(3) Gas vacuoles

(4) Centrioles

Answer (3)

Sol. Blue green algae, purple and green photosynthetic bacteria have gas vacuole as inclusion bodies.

96. Which of the following is the correct floral formula of Liliaceae?

(1) $\oplus \male\female \, K_{(5)} \, \widehat{C_{(5)}} \, A_5 \, \underline{G}_{(2)}$
(2) $\% \male\female \, C_{1+2+(2)} \, A_{(9)+1} \, \underline{G}_1$

(3) $\oplus \male \female \, K_{(5)} \, \widehat{C_{(5)}} \, A_5 \, \underline{G}_{(2)}$
(4) $Br \, \oplus \male\female \, \widehat{P_{(3+3)}} \, A_{3+3} \, G_{(3)}$

Answer (4)

Sol. The floral formula of liliaceae family is

$Br \, \oplus \male\female \, \widehat{P_{(3+3)}} \, A_{3+3} \, G_{(3)}$
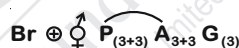
97. Male and female gametophytes do not have an independent free living existence in:

(1) Bryophytes
(2) Pteridophytes

(3) Algae
(4) Angiosperms

Answer (4)

Sol. Male and female gametophytes do not have free living existence in angiosperms

98. In the following in each set a conservation approach and an example of method of conservation are given

(a) In situ conservation   - Biosphere Reserve

(b) Ex situ conservation   - Sacred groves

(c) In situ conservation   - Seed bank

(d) Ex situ conservation   - Cryopreservation

Select the option with correct match of approach and method:

(1) (a) and (b)
(2) (a) and (c)

(3) (a) and (d)
(4) (b) and (d)

Answer (3)

Sol. *In-situ* conservation - Biosphere reserve

Ex-situ conservation - Cryopreservation

Hence (a) & (d) are correct.

Seed banks - *Ex-situ* conservation

Sacred groves - *In-situ* conservation

99. Inhibitory substances in dormant seeds cannot be removed by subjecting seeds to:

(1) Chilling conditions

(2) Gibberellic acid

(3) Nitrate

(4) Ascorbic acid

Answer (4)

Sol. Exposure to chilling temperature, gibberellins and nitrates break seed dormancy.

However, presence of ascorbic acid promotes seed dormancy.

100. In some plants thalamus contributes to fruit formation. Such fruits are termed as:

(1) Parthenocarpic fruit

(2) False fruits

(3) Aggregate fruits

(4) True fruits

Answer (2)

Sol. In some plants like apple and pear fruits are formed by thalamus along with ovary. They are called false fruits.

101. The biosynthesis of ribosomal RNA occurs in:

(1) Nucleolus

(2) Ribosomes

(3) Golgi apparatus

(4) Microbodies

Answer (1)

Sol. Biosynthesis of rRNA occurs in nucleolus.

102. Match the following techniques or instruments with their usage:

(a) Bioreactor		(i)	Separation of DNA fragments
(b) Electrophoresis		(ii)	Production of large quantities of products
(c) PCR		(iii)	Detection of pathogen, based on antigen-antibody reaction
(d) ELISA		(iv)	Amplification of nucleic acids

Select the correct option from following:

(1) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

(2) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(3) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Answer (3)

Sol. The correct answer is option (3) as (a) in column *i.e.* bioreactor matches with (ii) production of large quantities of products.

Electrophoresis is used for separation of DNA fragments so, (b) matches with (i)

PCR is polymerase chain reaction that is employed for amplification of nucleic acids, so (c) matches with (iv).

ELISA stands for enzyme linked immunosorbent assay and it is used for detection of pathogen based on antigen-antibody interaction, so (d) matches with (iii).

103. Large, empty colourless cells of the adaxial epidermis along the veins of grass leaves are

(1) Bulliform cells

(2) Lenticels

(3) Guard cells

(4) Bundle sheath cells

Answer (1)

Sol. Large, empty, colourless cells of adaxial epidermis of grasses *i.e.* monocots is called bulliform cells.

104. In a mixture, DNA fragments are separated by

(1) Polymerase chain reaction

(2) Bioprocess engineering

(3) Restriction digestion

(4) Electrophoresis

Answer (4)

Sol. The correct answer is option (4) as DNA fragments can be separated by a technique known as gel electrophoresis.

Polymerase chain reaction is used to amplify nucleic acids.

Bioprocess engineering comprises maintenance of sterile ambience in chemical engineering processes to enable growth of only the desired microbes eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines etc.

Restriction digestion is performed by incubating purified DNA molecules with the restriction enzyme, at optimal conditions.

105. Which of the following is incorrect for wind-pollinated plants?

(1) Pollen grains are light and non-sticky

(2) Well exposed stamens and stigma

(3) Many ovules in each ovary

(4) Flowers are small and not brightly coloured

Answer (3)

Sol. Wind pollinated flowers usually possess single ovule in each ovary.

106. In a mitotic cycle, the correct sequence of phases is

(1) G_1, G_2, S, M

(2) S, G_1, G_2, M

(3) G_1, S, G_2, M

(4) M, G_1, G_2, S,

Answer (3)

Sol. In a mitotic cycle the correct sequence of phases are G_1, S, G_2, M.

107. Embryological support for evolution was proposed by

(1) Alfred Wallace

(2) Ernst Heckel

(3) Karl Ernst vol Baer

(4) Charles Darwin

Answer (2)

Sol. The correct answer is option (2) embryological support for evolution was proposed by Ernst Heckel, based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

Alfred Wallace, a naturalist who worked in Malay Archipelago had concluded that natural selection act as mechanism of evolution.

Karl Ernst von Baer disapproved the proposal given by Ernst Hackel and proposed that embryos never pass through the adult stages of other animals.

Charles Darwin proposed natural selection as mechanism of evolution.

108. Phycoerythrin is the major pigment in

(1) Brown algae

(2) Red algae

(3) Blue green algae

(4) Green algae

Answer (2)

Sol. Phycoerythrin is the major pigment in red algae.

109. According to Alexander von Humboldt

(1) Species richness goes on increasing with increasing area of exploration

(2) Species richness decreases with increasing area of exploration

(3) Species richness increases with increasing area, but only up to limit

(4) There is no relationship between species richness and area explored

Answer (3)

Sol. As per species area relationship curve of Alexander von Humboldt the species richness increases with increasing area but only upto certain limit.

110. In the polynucleotide chain of DNA, a nitrogenous base is linked to the –OH of

(1) 1′ C pentose sugar

(2) 2′ C pentose sugar

(3) 3′ C pentose sugar

(4) 5′ C pentose sugar

Answer (1)

Sol. The correct answer is option (1) as in the polynucleotide chain of DNA, a nitrogenous base is linked to the –OH of 1′ C of pentose sugar.

Option (3) and (4) are incorrect as phosphodiester bond is present between 3′ carbon of sugar of one nucleotide to the 5′ carbon of the sugar of the succeeding nucleotide.

111. During non-cyclic photophosphorylation, when electrons are lost from the reaction centre at PS II, what is the source which replaces these electrons?

(1) Light

(2) Oxygen

(3) Water

(4) Carbon dioxide

Answer (3)

Sol. The electrons lost from reaction centre of photosystem II are replaced by water.

112. In Recombinant DNA technology antibiotics are used

    (1) As selectable markers

    (2) To keep medium bacteria-free

    (3) to detect alien DNA

    (4) To impart disease-resistance to the host plant

Answer (2)

Sol. The correct answer is option (2) because antibiotics are used in RDT to keep medium or culture bacteria-free.

Selectable marker helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants. They undergo insertional inactivation upon addition of alien DNA in their ORF.

113. Which of the following statements is incorrect?

    (1) Energy content gradually decreases from first to fourth trophic level

    (2) Biomass decreases from first to fourth trophic level

    (3) Energy content gradually increases from first to fourth trophic level

    (4) Number of individuals decreases from first trophic level to fourth trophic level

Answer (3)

Sol. Energy content does not remain trapped permanently in any organism. It is passed on to various trophic levels in food chain.

Hence, energy content gradually decreases from first (T_1) to fourth (T_4) trophic level by following ten percent law proposed by Lindemann.

114. Attachment of spindle fibers to kinetochores of chromosomes becomes evident in

    (1) Metaphase

    (2) Anaphase

    (3) Telophase

    (4) Prophase

Answer (1)

Sol. Spindle fibres attach to kinetochore of chromosome in metaphase and are clearly evident here.

115. Correct position of floral parts over thalamus in mustard plant is

    (1) Gynoecium is situated in the centre, and other parts of the flower are located at the rim of the thalamus, at the same level.

    (2) Gynoecium occupies the highest position, while the other parts are situated below it.

    (3) Margin of the thalamus grows upward, enclosing the ovary completely, and other parts arise below the ovary.

    (4) Gynoecium is present in the centre and other parts cover it partially.

Answer (2)

Sol. Mustard has hypogynous flower in which ovary/gynoecium occupies the highest position while other parts are situated below it.

116. After about how many years of formation of earth, life appeared on this planet?

    (1) 50 billion years   (2) 500 billion years

    (3) 50 million years   (4) 500 million years

Answer (4)

Sol. The correct answer is option (4) as life appeared 500 million years after the formation of earth. *i.e.* almost 4 billion years back.

117. The term 'Nuclein' for the genetic material was used by

    (1) Mendel   (2) Franklin

    (3) Meischer   (4) Chargaff

Answer (3)

Sol. The term 'Nuclein' for the genetic material was used by Friedrich Miescher.

118. Select the incorrect statement.

    (1) Elements most easily mobilized in plants from one region to another are : phosphorus, sulphur, nitrogen and potassium

    (2) Transport of molecules in phloem can be bidirectional

    (3) Movement of minerals in xylem is unidirectional

    (4) Unloading of sucrose at sink does not involve the utilization of ATP

Answer (4)

Sol. Unloading of sucrose at sink is an energy dependent process. Hence, it involves the utilization of ATP.

119. The number of contrasting characters studied by Mendel for his experiments was

(1) 7

(2) 14

(3) 4

(4) 2

Answer (1)

Sol. Mendel took 7 contrasting characters of pea plant for his experiment.

120. Vegetative propagule in Agave is termed as

(1) Eye

(2) Rhizome

(3) Bulbil

(4) Offset

Answer (3)

Sol. *Agave* vegetatively reproduces by large fleshy buds called bulbil.

121. Identify the statement which is **incorrect**.

(1) Tyrosine possesses aromatic ring in its structure

(2) Sulphur is an integral part of cysteine

(3) Glycine is an example of lipids

(4) Lecithin contains phosphorus atom in its structure

Answer (3)

Sol. Option (3) is the correct answer as glycine is an example of amino acid. R group in glycine is hydrogen.

122. A species which was introduced for ornamentation but has become a troublesome weed in India :

(1) *Trapa spinosa*

(2) *Parthenium hysterophorus*

(3) *Eichhornia crassipes*

(4) *Prosopis juliflora*

Answer (3)

Sol. *Eichhornia crassipes* was introduced in India by Queen Victoria for ornamentation but has become a troublesome weed in India.

123. Pyruvate dehydrogenase activity during aerobic respiration requires :

(1) Magnesium   (2) Calcium

(3) Iron   (4) Cobalt

Answer (1)

Sol. During link reaction Pyruvic acid is converted into Acetyl CoA with the help of Pyruvate dehydrogenase complex. For this conversion Pyruvate dehydrogenase requires magnesium, CoA, NAD^+, TPP and lipoic acid.

124. Identify the correct features of Mango and Coconut fruits.

(i) In both fruit is a drupe

(ii) Endocarp is edible in both

(iii) Mesocarp in Coconut is fibrous, and in Mango it is fleshy

(iv) In both, fruit develops from monocarpellary ovary

Select the correct option from below :

(1) (i) and (ii) only

(2) (i), (iii) and (iv) only

(3) (i), (ii) and (iii) only

(4) (i) and (iv) only

Answer (2)

Sol. Both Mango and Coconut fruits are drupe. They develop from monocarpellary ovary, but in both fruits edible part is different as shown below.

	Mango	Coconut
Epicarp	Skinny	Skinny
Mesocarp	Edible	Fibrous
Endocarp	Hard & stony	Hard & stony
Endosperm	Not edible	Edible

125. Match the items in Column I with those in Column II :

Column I		Column II
(a) Herbivores-Plants	(i)	Commensalism
(b) Mycorrhiza-Plants	(ii)	Mutualism
(c) Sheep-Cattle	(iii)	Predation
(d) Orchid-Tree	(iv)	Competition

Select the correct option from following :

(1) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

(2) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

(3) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(4) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

Answer (3)

Sol. (a) Herbivores-Plants – Predation (+, –)

(b) Mycorrhiza-Plants – Mutualism (+, +)

(c) Sheep-Cattle – Competition (–, –)

(d) Orchid-Tree – Commensalism (+, 0)

126. Air (Prevention and Control of Pollution) Act was amended in 1987 to include among pollutants

(1) Particulates of size 2.5 micrometer or below

(2) Vehicular exhaust

(3) Allergy causing pollen

(4) Noise

Answer (4)

Sol. Air (Prevention and Control of Pollution) Act was amended in 1987 to include noise as air pollutant.

127. In *Glycine max*, the product of biological nitrogen fixation is transported from the root nodules to other parts as

(1) Ureides (2) Ammonia

(3) Glutamate (4) Nitrates

Answer (1)

Sol. In *Glycine max* (Soyabean) the product of biological nitrogen fixation is transported from the root nodules to other parts in the form of ureides.

128. Which of the following statements about cork cambium is incorrect?

(1) It is a couple of layers thick

(2) It forms secondary cortex on its outerside

(3) It forms a part of periderm

(4) It is responsible for the formation of lenticels

Answer (2)

Sol. Cork cambium (Phellogen) is dedifferentiated tissue, so it is a secondary meristem. It is couple of layers thick and cuts off cork (Phellem) towards outer side and secondary cortex (Phelloderm) towards inner side

Phellem + Phellogen + Phelloderm together constitute periderm.

129. Match the following

(a) Aquaporin (i) Amide

(b) Asparagine (ii) Polysaccharide

(c) Abscisic acid (iii) Polypeptide

(d) Chitin (iv) Carotenoids

Select the correct option

(1) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

(2) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

(3) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Answer (2)

Sol. Chitin is homopolymer of N-acetylglucosamine, considered as homopolysaccharide

Aquaporin is a protein (polypeptide) found in many cell membranes

Asparagine is an amide of aspartic acid, hence carries more nitrogen than amino acid.

Abscisic acid (ABA) is carotenoid derivative plant hormone.

130. Which of the following statements is incorrect about gymnosperms?

(1) Their seeds are not covered

(2) They are heterosporous

(3) Male and female gametophytes are free living

(4) Most of them have narrow leaves with thick cuticle

Answer (3)

Sol. Gymnosperms have naked seeds. All of them are heterosporous. Male and female gametophytes do not have independent existence hence are not free living.

131. Which of the following elements helps in maintaining the structure of ribosomes?

(1) Molybdenum

(2) Magnesium

(3) Zinc

(4) Copper

Answer (2)

Sol. Magnesium is required to maintain the structure of ribosomes.

132. Match the following concerning the activity/ function and the phytohormone involved.

(a) Fruit ripener   (i) Abscisic acid

(b) Herbicide   (ii) GA$_3$

(c) Bolting agent   (iii) 2, 4-D

(d) Stress hormone   (iv) Ethephon

Select the correct option from following

(1) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

(2) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(3) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Answer (4)

Sol. (a) Fruit ripener – Ethephon (Ethylene helps in ripening of fruits)

(b) Herbicide – 2, 4-D (Auxin)

(c) Bolting agent – GA$_3$ (Gibberellin) [Helps in internode elongation]

(d) Stress hormone – Abscisic acid (ABA)

133. Who coined the term 'Kinetin'?

(1) Kurosawa   (2) Skoog and Miller

(3) Darwin   (4) Went

Answer (2)

Sol. Kinetin (Cytokinin) term was coined by Skoog and Miller.

134. Which of the following statements is incorrect regarding the phosphorus cycle?

(1) It is sedimentary cycle

(2) Phosphates are the major form of phosphorus reservoir

(3) Phosphorus solubilising bacteria facilitate the release of phosphorus from organic remains

(4) There is appreciable respiratory release of phosphorus into atmosphere

Answer (4)

Sol. Phosphorus cycle is sedimentary cycle. Rocks are major reservoir of phosphorus. There is no respiratory release of phosphorus into atmosphere.

Carbon is released during respiration.

135. First discovered restriction endonuclease that always cuts DNA molecule at a particular point by recognising a specific sequence of six base pairs is

(1) *Hind* II

(2) *EcoR* I

(3) Adenosine deaminase

(4) Thermostable DNA polymerase

Answer (1)

Sol. • The first restriction endonuclease is *Hind* II.

• *Eco*RI is obtained from *Escherichia coli* Ry13

• Thermostable DNA polymerase is used in PCR called Taq polymerase

• ADA enzyme is crucial for the immune system to function. In SCID, there is deficiency of ADA enzyme.

136. Which of the following is associated with decrease in cardiac output?

(1) Adrenal medullary hormones

(2) Sympathetic nerves

(3) Parasympathetic neural signals

(4) Pneumotaxic centre

Answer (3)

Sol. Option (3) is the correct answer. Parasympathetic neural signals decrease the rate of heart beat, speed of conduction of action potential, stroke volume and thereby the cardiac output.

Adrenal medullary hormones increase cardiac output.

Sympathetic neural signals increase the rate of heart beat, strength of ventricular contraction and thereby the cardiac output.

137. Match the following group of organisms with their respective distinctive characteristics and select the correct option

Organisms	Characteristics
(a) Platyhelminthes	(i) Cylindrical body with no segmentation
(b) Echinoderms	(ii) Warm blooded animals with direct development
(c) Hemichordates	(iii) Bilateral symmetry with incomplete digestive system
(d) Aves	(iv) Radial symmetry with indirect development

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(3) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(4) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Answer (2)

Sol. Option (2) is the correct answer. Birds and mammals are homeotherms (warm blooded). Metameric segmentation is present in annelids, Arthropods and chordates. Adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical. In most of the platyhelminths, single opening of digestive system serves the function of both mouth and anus.

138. Which is the basis of genetic mapping of human genome as well as DNA finger printing?

(1) Polymorphism in RNA sequence

(2) Polymorphism in DNA sequence

(3) Single nucleotide polymorphism

(4) Polymorphism in hnRNA sequence

Answer (2)

Sol. Polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as DNA fingerprinting.

139. The best example for pleiotropy is:

(1) ABO Blood group

(2) Skin colour

(3) Phenylketoneuria

(4) Colour Blindness

Answer (3)

Sol. Pleiotropic gene can exhibit multiple phenotypic expression.

An example of this is the disease phenylketonuria.

ABO blood group	– Multiple allelism
Skin colour	– Shows polygenic inheritance
Colour blindness	– Mendelian disorder

140. The total Lung Capacity (TLC) is the total volume of air accomodated in the lungs at the end of a forced inspiration. This includes:

(1) RV (Residual Volume);
   ERV (Expiratory Reserve Volume);
   TV (Tidal Volume); and
   IRV (Inspiratory Reserve Volume)

(2) RV; IC (Inspiratory Capacity);
   EC (Expiratory Capacity); and ERV

(3) RV; ERV; IC and EC

(4) RV; ERV; VC (Vital Capacity) and FRC (Functional Residual Capacity)

Answer (1)

Sol. The correct answer is option (1) as, total volume of air accomodated in the lungs at the end of a forced inspiration is called total lung capacity (TLC). It includes RV, ERV, TV and IRV.

141. Hormones stored and released from neurohypophysis are

(1) Prolactin and Vasopressin

(2) Thyroid stimulating hormone and Oxytocin

(3) Oxytocin and Vasopressin

(4) Follicle stimulating hormone and Leutinizing hormone

Answer (3)

Sol. Option (3) is the correct answer.

- Neurohypophysis stores and releases oxytocin and vasopressin.

- Prolactin, thyroid-stimulating hormone, FSH and LH are secreted by anterior pituitary.

142. According to Central Pollution Control Board [CPCB] what size (in diameter) of particulate is responsible for causing greater harm to human health?

    (1) 3.0 micrometers

    (2) 3.5 micrometers

    (3) 2.5 micrometers

    (4) 4.0 micrometers

Answer (3)

Sol. According to CPCB (Central Pollution Control Board), particulate less than 2.5 micrometers (in diameter) is responsible for causing greater harm to human health.

143. Cyclosporin A, used as immunosuppression agent, is produced from

    (1) *Trichoderma polysporum*

    (2) *Monascus purpureus*

    (3) *Saccharomyces cerevisiae*

    (4) *Penicillium notatum*

Answer (1)

Sol. Cyclosporin A, used as immuno-suppressive agent in organ-transplant patients is produced from *Trichoderma polysporum* (A fungus).

144. For the commercial and industrial production of Citric Acid, which of the following microbes is used?

    (1) *Clostridium butylicum*

    (2) *Aspergillus niger*

    (3) *Lactobacillus sp*

    (4) *Saccharomyces cerevisiae*

Answer (2)

Sol. *Aspergillus niger* (a fungus) is producer of citric acid for the commercial and industrial purposes.

145. All vertebrates are chordates but all chordates are not vertebrates, why?

    (1) All chordates possess notochord throughout their life.

    (2) Notochord is replaced by vertebral column in adult of some chordates

    (3) Ventral hollow nerve cord remains throughout life in some chordates.

    (4) All chordates possess vertebral column.

Answer (2)

Sol. The correct answer is option (2) because the members of subphylum vertebrata possess notochord during the embryonic period. So, all vertebrates are chordates. The notochord is replaced by a cartilaginous or bony vertebral column in the adult vertebrates. In protochordates, vertebral column is not formed. In urochordates, notochord is present only in tail region in larval stage and in cephalochordates, it persists throughout life so all chordates are not vertebrates.

146. The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called

    (1) Adaptive radiation

    (2) Saltation

    (3) Co-evolution

    (4) Natural selection

Answer (1)

Sol. The correct answer is option (1) because the process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography is called adaptive radiation.

- Saltation is single step large mutation.

- When one organism evolves *w.r.t* evolution in another organism, it is called co-evolution. e.g. Host-parasite relationship

- Natural selection is the process through which population of living organisms that adapt are selected by nature based on reproductive fitness

147. *E. coli* has only 4.6×10^6 base pairs and completes the process of replication within 18 minutes; then the average rate of polymerisation is approximately

(1) 1000 base pairs/second

(2) 2000 base pairs/second

(3) 3000 base pairs/second

(4) 4000 base pairs/second

Answer (2)

Sol. The average rate of polymerisation of DNA in *E.coli* is 2000 bp per second. It has only 4.6×10^6 bp and completes the process of replication within 18 minutes

148. The size of Pleuropneumonia - like organism (PPLO) is

(1) 0.1 μm

(2) 0.02 μm

(3) 1 – 2 μm

(4) 10 – 20 μm

Answer (1)

Sol. The size of PPLO is 0.1 μm. It is the smallest living organism.

149. Intrinsic factor that helps in the absorption of vitamin B_{12} is secreted by

(1) Chief cells

(2) Goblet cells

(3) Hepatic Cells

(4) Oxyntic cells

Answer (4)

Sol. The correct answer is option (4) because parietal or oxyntic cells secrete HCl and intrinsic factor (factor essential for absorption of vitamin B_{12}) .

Peptic or chief cells secrete proenzyme pepsinogen. Goblet cells secrete mucus. Hepatic cells secrete bile.

150. Match the following columns with reference to cockroach and select the correct option:

Column-I	Column-II
(a) Grinding of the food particles	(i) Hepatic caecae
(b) Secrete gastric juice	(ii) 10th segment
(c) 10 pairs	(iii) Proventriculus
(d) Anal Cerci	(iv) Spiracles
	(v) Alary muscles

(1) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

(2) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

(3) (a)-(iv), (b)-(iii), (c)-(v), (d)-(ii)

(4) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)

Answer (2)

Sol. The correct answer is option (2) because proventriculus or gizzard has an outer layer of thick circular muscles and thick inner cuticle forming six highly chitinous plate called teeth which help in grinding of food particles.

Hepatic caecae secrete gastric juice. Spiracles are 10 pairs in number.

In both male and female cockroach, 10th segment bears a pair of jointed filamentous structures called anal cerci.

151. The increase in osmolarity from outer to inner medullary interstitium is maintained due to :

(i) Close proximity between Henle's loop and vasa recta

(ii) Counter current mechanism

(iii) Selective secretion of HCO_3^- and hydrogen ions in PCT

(iv) Higher blood pressure in glomerular capillaries

(1) (i) and (ii)

(2) Only (ii)

(3) (iii) and (iv)

(4) (i), (ii) and (iii)

Answer (1)

Sol. The correct answer is option (1) as both the statements (i) and (ii) are correct because counter current mechanism is based on special arrangement of Henle's loop and vasa recta and this mechanism maintain a concentration gradient in the medullary interstitium.

Statement (iii) is incorrect as PCT helps in selective secretion of H^+, ammonia and K^+ ions and reabsorption of HCO_3^- from it.

Statement (iv) i.e. blood pressure in glomerular capillaries is responsible for glomerular filtration and not for counter current mechanism.

152. Select the correct statement :

    (1) Reduction in Glomerular Filtration Rate activates JG cells to release renin.

    (2) Atrial Natriuretic Factor increases the blood pressure.

    (3) Angiotensin II is a powerful vasodilator.

    (4) Counter current pattern of blood flow is not observed in vasa recta.

Answer (1)

Sol. The correct answer is option (1) because a fall in GFR/blood flow can activate the JG cells to release renin.

Option (2) is incorrect statement as ANF causes vasodilation and thereby decrease the blood pressure.

Option (3) is incorrect statement as Angiotensin II, being a powerful vasoconstrictor, increases blood pressure.

Option (4) is incorrect statement as counter current pattern is observed between Henle's loop and vasa recta.

153. Which of the following STDs are not curable?

    (1) Gonorrhoea, Trichomoniasis, Hepatitis B

    (2) Genital herpes, Hepatitis B, HIV infection

    (3) Chlamydiasis, Syphilis, Genital warts

    (4) HIV, Gonorrhoea, Trichomoniasis

Answer (2)

Sol. The correct answer is option (2) because Hepatitis-B, Genital herpes and HIV infections are not curable. Other diseases given in option (1), (3) and (4) are completely curable if detected early and treated properly such as Gonorrhoea, Chlamydiasis, Syphilis, Trichomoniasis.

154. Match the following columns and select the correct option :

Column-I	Column-II
(a) Smooth endoplasmic reticulum	(i) Protein synthesis
(b) Rough endoplasmic reticulum	(ii) Lipid synthesis
(c) Golgi complex	(iii) Glycosylation
(d) Centriole	(iv) Spindle formation

    (1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

    (2) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

    (3) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

    (4) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

Answer (2)

Sol. (a) Smooth Endoplasmic Reticulum (SER) → Lipid synthesis

(b) Rough Endoplasmic Reticulum (RER) → Protein synthesis

(c) Golgi Complex → Glycosylation

(d) Centriole → Spindle formation

155. A Hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was

    (1) *Australopithecus*   (2) *Homo erectus*

    (3) Neanderthal man   (4) *Homo sapiens*

Answer (2)

Sol. The correct answer is option (2) because fossils recovered in Java in 1891, about 1.5 mya, was *Homo erectus* and had a large brain around 900 cc.

Option (1) is incorrect because *Australopithecus* probably lived in East African grasslands, about two mya.

Option (3) is incorrect because cranial capacity for Neanderthal man was 1400 cc.

Option (4) is incorrect because *Homo sapiens* arose during ice age between 75,000 to 10,000 years ago.

156. The protcolytic enzyme rennin is found in :

    (1) Pancreatic juice   (2) Inteatinal juice

    (3) Bile juice   (4) Gastric juice

Answer (4)

Sol. The correct answer is option (4) because Rennin is proteolytic enzyme found in gastric juice of infants which helps in the digestion of milk proteins.

Option (1) is incorrect as proteolytic enzymes found in pancreatic juice are trypsin, chymotrypsin, carboxypeptidase *etc*.

Option (2) is incorrect as proteolytic enzymes found in intestinal juice are dipeptidases.

Option (3) is incorrect as no enzyme is present in bile juice.

157. Match the following columns and select the correct option :

Column - I		Column - II	
(a)	Dragonflies	(i)	Biocontrol agents of several plant pathogens
(b)	*Bacillus thuringiensis*	(ii)	Get rid of Aphids and mosquitoes
(c)	Glomus	(iii)	Narrow spectrum insecticidal applications
(d)	Baculoviruses	(iv)	Biocontrol agents of lepidoteran plant pests
		(v)	Absorb phosphorus from soil

(1) (a)-(ii), (b)-(iv), c-(v), (d)-(iii)

(2) (a)-(iii), (b)-(v), c-(iv), (d)-(i)

(3) (a)-(ii), (b)-(i), c-(iii), (d)-(iv)

(4) (a)-(ii), (b)-(iii), c-(iv), (d)-(v)

Answer (1)

Sol. (a) Dragonflies → Get rid of Aphids and mosquitoes.

(b) *Bacillus thuringiensis* → Biocontrol agents of lepidopteran plant pests.

(c) *Glomus* → Absorbs phosphorus from soil

(d) Baculoviruses → Narrow spectrum insecticidal application

158. Select the incorrectly matched pair from following :

(1) Ostcocytes - Bone cells

(2) Chondrocytes - Smooth muscle cells

(3) Neurons - Nerve cells

(4) Fibroblast - Areolar tissue

Answer (2)

Sol. The correct answer is option (2) because chondrocytes are not present in smooth muscles but are cells present in cartilage.

Chondrocytes are enclosed in small cavities within the matrix secreted by them.

159. The yellowish fluid "colostrum" secreted by mammary glands of mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant. This type of immunity is called as :

(1) Autoimmunity

(2) Passive immunity

(3) Active immunity

(4) Acquired immunity

Answer (2)

Sol. Option (2) is correct answer as colostrum is first milk, yellowish fluid secreted by mammary glands of mother during initial days of lactation. It contains IgA antibodies to protect the infants. Such type of immunity in which readymade antibodies reach the body of infants, is called natural passive immunity.

160. Select the correct option of haploid cells from the following groups:

(1) Primary spermatocyle, Secondary spermatocyte, Second polar body

(2) Primary oocyte, Secondary oocyte, Spermatid

(3) Secondary spermatocyte, First polar body, Ovum

(4) Spermatogonia, Primary spermatocyte, Spermatid

Answer (3)

Sol. Option (3) is the correct answer as primary spermatocyte and primary oocyte are diploid structures. Secondary oocyte, ovum, first and second polar body are haploid structures.

161. During Meiosis I, in which stage synapsis takes place?

(1) Leptotene

(2) Pachytene

(3) Zygotene

(4) Diplotene

Answer (3)

Sol. Synapsis is a process by which homologous chromosomes come to lie side by side in pairs.

The process of synapsis takes place during zygotene stage of prophase-I of meiosis-I.

162. Select the correct statement from the following :

(1) PCR is used for isolation and separation of gene of interest

(2) Gel electrophoresis is used for amplification of a DNA segment

(3) The polymerase enzyme joins the gene of interest and the vector DNA

(4) Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzymes of optimum conditions

Answer (4)

Sol. Option (4) is the correct answer. PCR is used for amplification of DNA. Gel electrophoresis is used for separation of digested DNA fragments. Ligase enzyme joins the gene of interest and vector DNA.

163. Spooling is

(1) Collection of isolated DNA

(2) Amplification of DNA

(3) Cutting of separated DNA bands from the agarose gel

(4) Transfer of separated DNA fragments to synthetic membranes

Answer (1)

Sol. Option (1) is correct answer as spooling refers to wrapping of DNA around a glass rod while extracting DNA. Option (2) is incorrect as amplification is done by PCR. Cutting of separated DNA bands from the agarose gel is elution. Transfer of separated DNA fragments to synthetic memberane is done in blotting.

164. Match the following columns and select the correct option:

Column-I	Column-II
(a) Ovary	(i) Human chorionic Gonadotropin
(b) Placenta	(ii) Estrogen & Progesterone
(c) Corpus luteum	(iii) Androgens
(d) Leydig cells	(iv) Progesterone only

(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(2) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(3) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(4) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

Answer (1)

Sol. The correct answer is option (1) because hCG (human chorionic gonadotropin) is secreted by placenta.

Leydig cells secrete androgens. Ovary secretes both estrogen and progesterone. Follicles present in ovary secrete estrogen and corpus luteum secretes progesterone.

165. Match the following columns and select the correct option:

Column-I	Column-II
(a) Pituitary hormone	(i) Steroid
(b) Epinephrine	(ii) Neuropeptides
(c) Endorphins	(iii) Peptides, proteins
(d) Cortisol	(iv) Biogenic amines

(1) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(2) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(3) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(4) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Answer (3)

Sol. Option (3) is the correct answer as cortisol is a steroidal hormone. Endorphins are natural painkillers that are neuropeptides.

Epinephrine/adrenaline is a catecholamine and a biogenic amine.

166. The laws and rules to prevent unauthorised exploitation of bio-resources are termed as

(1) Biopiracy

(2) Biopatenting

(3) Bioethics

(4) Bioengineering

Answer (3)

Sol. The correct answer is option (3) as bioethics prevent /control biopiracy

Biopiracy is the term used to refer to the use of bioresources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment.

167. Match the following columns and select the correct option :

Column - I	Column - II
(i) Typhoid	(a) *Haemophilus influenzae*
(ii) Malaria	(b) *Wuchereria bancrofti*
(iii) Pneumonia	(c) *Plasmodium vivax*
(iv) Filariasis	(d) *Salmonella typhi*

(1) (i)-(a), (ii)-(b), (iii)-(d), (iv)-(c)

(2) (i)-(d), (ii)-(c), (iii)-(a), (iv)-(b)

(3) (i)-(c), (ii)-(d), (iii)-(b), (iv)-(a)

(4) (i)-(a), (ii)-(c), (iii)-(b), (iv)-(d)

Answer (2)

Sol. Option (2) is the correct answer. Filariasis is elephantiasis in which flow of lymph is blocked. Typhoid spreads through fecal oral route. Pneumonia can be caused due to bacteria, virus, fungi *etc*. Malaria is caused by sporozoan *P. vivax*.

168. RNA interference is used for which of the following purposes in the field of biotechnology?

(1) to reduce post harvest losses

(2) to develop a plant tolerant to abiotic stresses

(3) to develop a pest resistant plant against infestation by nematode

(4) to enhance the mineral usage by the plant

Answer (3)

Sol. Option (3) is the correct answer. Transgenic tobacco plants using RNAi exhibit resistance to nematode *Meloidogyne incognita*. Many GM crops show reduced post harvest losses and exhibit resistance to abiotic stresses but that is not the aim of RNAi.

169. The rate of decomposition is faster in the ecosystem due to following factors EXCEPT

(1) Detritus richer in lignin and chitin

(2) Detritus rich in sugars

(3) Warm and moist environment

(4) Presence of aerobic soil microbes

Answer (1)

Sol. The rate of decomposition is slow if it contains lignin, chitin, tannins (Phenolics) and cellulose.

170. Which of the following conditions cause erythroblastosis foetalis?

(1) Both mother and foetus Rh^{+ve}

(2) Mother Rh^{+ve} and foetus Rh^{-ve}

(3) Mother Rh^{-ve} and foetus Rh^{+ve}

(4) Both mother and foetus Rh^{-ve}

Answer (3)

Sol. Option (3) is correct answer because Erythroblastosis foetalis occurs only when foetus is Rh^{+ve} and mother is Rh^{-ve}. During Ist delivery, if Rh^{+ve} foetal blood mixes with mother's blood, antibodies are produced in mother's body against Rh antigen. These antibodies in successive pregnancies cross placental barrier and reach foetus, causing clumping of RBCs in foetus.

171. In Human beings, at the end of 12 weeks(first trimester) of pregnancy, the following is observed :

(1) Movement of the foetus

(2) Eyelids and eyelashes are formed

(3) Most of the major organ systems are formed

(4) The head is covered with fine hair

Answer (3)

Sol. The correct answer is option (3). Early movements of foetus are evident around 20 weeks of human pregnancy. By the end of 24 weeks, eyelids separate and eyelashes are formed and the body is covered with fine hair.

172. Progestogens alone or in combination with estrogens can be used as a contraceptive in the form of

(1) Pills only

(2) Implants only

(3) Injections only

(4) Pills, injections and implants

Answer (4)

Sol. Option (4) is the correct answer as progesterone alone or in combination with estrogens can be used as a contraceptive in the form of pills, injections and implants. They can act by inhibiting ovulation, implantation as well as altering the quality of cervical mucus.

173. Which of the following options does correctly represent the characteristic features of phylum Annelida?

(1) Diploblastic, mostly marine and radially symmetrical.

(2) Triploblastic, unsegmented body and bilaterally symmetrical.

(3) Triploblastic, segmented body and bilaterally symmetrical.

(4) Triploblastic, flattened body and acoelomate condition.

Answer (3)

Sol. Option (3) is the correct answer as members of phylum Annelida are segmented worms exhibiting triploblasty. Acoelomate condition and bilateral symmetry are seen in members of phylum Platyhelminthes.

174. Inbreeding depression is

(1) Reduced fertility and productivity due to continued close inbreeding

(2) Reduced motility and immunity due to close inbreeding

(3) Decreased productivity due to mating of superior male and inferior female

(4) Decrease in body mass of progeny due to continued close inbreeding

Answer (1)

Sol. Option (1) is the correct answer as continued inbreeding especially close inbreeding, usually reduces fertility and even productivity.

Outcrossing can help overcome inbreeding depression.

175. Match the following columns and select the correct option :

Column - I	Column - II
(a) Rods and Cones	(i) Absence of photoreceptor cells
(b) Blind Spot	(ii) Cones are densely packed
(c) Fovea	(iii) Photoreceptor cells
(d) Iris	(iv) Visible coloured portion of the eye

(1) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

(2) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

(3) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

(4) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Answer (2)

Sol. Option (2) is the correct answer because rods and cones are photoreceptor cells absent in the region of blind spot. Fovea is thinned out portion of macula where only cones are densely packed. Iris is visible coloured portion of eye.

176. Match the following columns and select the correct option :

Column-I	Column - II
(a) Pneumotaxic Centre	(i) Alveoli
(b) O_2 Dissociation curve	(ii) Pons region of brain brain
(c) Carbonic Anhydrase	(iii) Haemoglobin
(d) Primary site of exchange of gases	(iv) R.B.C.

(1) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

(2) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

(3) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(4) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

Answer (3)

Sol. The correct answer is option (3) because pneumotaxic centre is present in the pons region of the brain.

In O_2 dissociation curve, percentage saturation of haemoglobin is plotted against the pO_2. Carbonic anhydrase is mainly present in the RBCs and its minute quantity is present in the plasma.

Alveoli are the primary sites of exchange of gases.

177. Match the following columns and select the correct option :

Column - I	Column - II
(a) Gout	(i) Decreased levels of estrogen
(b) Osteoporosis	(ii) Low Ca^{++} ions in the blood
(c) Tetany	(iii) Accumulation of uric acid crystals
(d) Muscular dystrophy	(iv) Auto immune disorder
	(v) Genetic disorder

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(iv)

(3) (a)-(iii), (b)-(i), (c)-(ii), (d)-(v)

(4) (a)-(iv), (b)-(v), (c)-(i), (d)-(ii)

Answer (3)

Sol. The correct answer is option (3) as Gout is inflammation of joints due to accumulation of uric acid crystals, so (a) in column I matches with (iii) in column II.

Osteoporosis, (b) in column I, is an age-related disorder and as its common cause is decreased levels of estrogen, so it matches with (i) in column II.

(c) in column I matches with (ii) in column II as in tetany rapid spasms occur in muscles due to low Ca^{2+} in body fluid.

(d) In column I matches with (v) in column II because muscular dystrophy is progressive degeneration of skeletal muscle mostly due to genetic disorder. Myasthenia gravis is an autoimmune disorder, (iv) option given in column II.

178. Match the following columns and select the correct option :

Column-I	Column-II
(a) *Aptenodytes*	(i) Flying fox
(b) *Pteropus*	(ii) Angel fish
(c) *Pterophyllum*	(iii) Lamprey
(d) *Petromyzon*	(iv) Penguin

(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(2) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(4) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Answer (4)

Sol. Option (4) is the correct answer. *Aptenodytes* is penguin (a bird) and is classified under Aves. *Pteropus* is categorised under Mammalia. *Pterophyllum* is a bony fish classified under osteichthyes. *Petromyzon* is categorised as a cyclostome.

179. In cockroach, identify the parts of the foregut in correct sequence :

(1) Mouth → Pharynx → Oesophagus → Crop → Gizzard

(2) Mouth → Oesophagus → Pharynx → Crop → Gizzard

(3) Mouth → Crop → Pharynx → Oesophagus → Gizzard

(4) Mouth → Gizzard → Crop → Pharynx → Oesophagus

Answer (1)

Sol. Option (1) is the correct answer as the correct sequence of parts of the foregut in cockroach are :

Mouth → Pharynx → Oesophagus → Crop → Gizzard.

180. Match the following events that occur in their respective phases of cell cycle and select the correct option :

(a) G_1 phase	(i) Cell grows and organelle duplication
(b) S phase	(ii) DNA replication and chromosome duplication
(c) G_2 phase	(iii) Cytoplasmic growth
(d) Metaphase in M-phase	(iv) Alignment of chromosomes

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(4) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Answer (1)

Sol. Phases of cell cycle and their respective events are :

(a) G_1 phase – Cell grows and cell organelle duplication

(b) S phase – DNA replication and chromosome duplication

(c) G_2 phase – Cytoplasmic growth

(d) Metaphase in M-phase – Alignment of chromosomes

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